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Friendly Suggestions To Roundhouse Foreman

By E. C. Williams*

(Editor's Note: A roundhouse foreman, working long hours under heavy stress, kindly gave us an account of part of his night's duties. This was published in the May, 1935, *Railway Mechanical Engineer*, pages 207-8. Since its publication we have received many letters from enginehouse foremen, most of them commending the article and telling of their own experiences. An extract from one of these letters was given in our June number, page 241.

One letter, however, has been received from a boiler foreman, Mr. Williams, in which he takes exception to the roundhouse foreman's point of view and frankly comments on the practices described in the "Daily Log." We pass it on to our readers with no comment, but in the expectation that the ensuing discussions will prove helpful to all concerned.)

* * * * *

As a supervisor—I have held the position of boiler foreman for several years, with experience in both the roundhouse and the back shop—I believe I know the conditions and circumstances that railroad shops are trying to exist through and overcome throughout our country today. With this background, and with no intention of starting a controversy, I should like to comment on "The Roundhouse Foreman's Daily Log," which appeared in your May number.

An Executive, Not a Mechanic

First, I want to try to make myself clear on the point of supervision, as I see and experience it. A supervisor should so train and educate his men that he can eliminate the strain of any actual work other than his regular duties, in order that he will be more beneficial to the railroad, to himself and to the men who work under him. No supervisor can do it all by himself; without the co-operation and good workmanship of those under him, he is doomed to be a complete failure.

From the first paragraph of the "Daily Log" it is apparent that there must be some friction and ill feeling between the day and night supervisory forces of this particular roundhouse. Such a condition should not exist, and I am wondering where the fault lies. Is it the day foremen or the night foreman that will not fall in line? Or perhaps it may be that all three of them are at fault. Regardless of where the fault lies, it must be corrected before the best results can be attained by their supervision.

Life is just what we make it, regardless of where we may be, and we must remember that our jobs are not any more important than the other fellow's. We may have more responsibility, it is true, but under all conditions there must be co-operation and the spirit of fellowship for any kind of an organization to prosper.

In my opinion, a supervisor is very little more important than the men he directs. The only difference that I can see is that he applied his ability and knowledge—and perhaps his personality of leadership stood out a little from his fellow workers—and because of this he was picked to shoulder the responsibility.

Still Working 12 Hours a Day

(Taken from a letter from a roundhouse foreman)

A foreman should have the vitality to vigorously supervise his men. A foreman's gestures and personality should be vigorous and of course stimulating to the men. How can this be expected when his hours are 50 per cent longer and more strenuous than those of his men? Years ago the foremen and men worked 12 hours. As modern power came into the picture, faster schedules and production increased, the men had to produce more work of a more exact nature, their work became more laborious, their hours were finally reduced to eight, to offset the strain.

The enginehouse foreman is unfortunately still working 12 hours. Isn't it remarkable that he functions as well as he does? May I ask you what you really think these last four hours are costing the company—a chance for a good investment I believe.

* Shreveport, La.

There is also room for criticism in the second paragraph of the "Daily Log." As officer in charge, the day foreman should and must know that the work was performed and the engine was O.K. for service before placing his signature of approval on the boiler form.

Seniority and Incompetency

A complaint was registered by the roundhouse foreman in his "Daily Log" in regard to an erecting shop machinist exercising his seniority and placing himself in the roundhouse when the erecting shop closed down. I am of the opinion that there is a lack of co-operation between the day foreman and the night foreman, or they would not allow an incompetent man to go on the night shift. The night force should not be a dumping ground for such a man as this, and he should not have been allowed to exercise his seniority, if he was not capable of doing the work.

There should not be left on any railroad today a mechanic that is a specialist; while it is true there are special jobs, such as airman, valveman, etc., nevertheless, the men assigned to these jobs should be capable of performing any duty that they may be called upon to do in their line of work.

Any craftsman that has been assigned to back shop work who is not competent to carry on in the roundhouse, should not for several reasons, be allowed under any circumstances to exercise his seniority. The most logical reason is that all railroads are subject to drastic rules and regulations in regard to mechanism of locomotives and parts thereof, and we all know that if a mechanic does not know a defect it will be almost impossible for him to correct it if it exists on a locomotive; if this kind of man is allowed to remain on the job it is probable that a serious failure or accident will eventually happen, which will cause trouble and maybe loss of life to some innocent person.

Must Have Trustworthy Mechanics

No foreman can see every job as it is assembed, so he must have men that he can trust; he must know that he has men with mechanical ability who will carry on at all times. No matter what practical and executive ability a foreman has, he is bound to slip if he has any such mechanics working for him as the man "Johnson," referred to in the "Log."

The only thing commendable in the "Log" is the one machinist who received the proper training somewhere. This man was playing his part and when he caught up, didn't go on the "spot," but went on to another engine to help get it ready for service.

The boilermaker must have been on the "spot" when the foreman had to hook up the blow-down line and make an interior inspection of the firebox to prevent any possible delay in getting the engine out of the house. It seems to me this is brought about by the foreman not sufficiently impressing on all of his men the great importance of each and every one doing his part.

It is true that the duties of a roundhouse foreman have increased considerably, but not any more than the other foremen who brush shoulders with him daily.

A Personal Illustration

Allow me to make a personal demonstration and use my job as an illustration.

Being a boiler foreman I am responsible for all engines on the division on which I am employed. I am not fortunate enough to have any boiler inspector, so I have to make all daily, monthly and annual inspections personally, as well as keep a close observation for any minor defects that may arise. I have to supervise and direct the men under me and be responsible for all cab cards, washout records and other clerical duties that may have to be performed in my line of work.

I have occasionally relieved the roundhouse foreman when he was on leave of absence and after performing all these duties I am not of the opinion that my job is a man-killing one and one-man job. On the contrary, no one man can be a successful supervisor without the help of others. I mean that I have done my best to train my men to carry on and do their work, correcting all defects in accordance with rules and regulations, while I am performing some of my other duties.

Don't Let Jobs Master Us

Our jobs are just what we make them; maybe some of us are on jobs that master us, instead of us mastering the job. We should find the best job we are fitted for, then things will come a whole lot easier.

In conclusion I want to say that all of us are loaded to capacity with duties and it is no use to grumble and complain, because every one is too busy to listen to anything other than something pleasing. The only advice I know is to keep your chin up and carry on to the best of your ability.

As far as recreation is concerned, if one handles his job right there can be such a thing as recreation while on duty; however, I get plenty off duty. While on duty you must remember that your time belongs to the railroad, but when you are off duty forget the cares and worries of your responsible position and then you can enjoy yourself and be refreshed when it comes your turn to go on the race track.

Salary Compared to Workers' Wages

(Taken from a letter from a roundhouse foreman)

If I were extended the same consideration as is extended to all other men, shop and road, I would be allowed time-and-a-half after eight hours. At this rate I would be working for 65 cents per hour—less than an unskilled mechanic receives—and the foremen are selected because of their experience and ability. Logical, isn't it? Any railroad man working my hours would receive 420 hours for 30 days. My salary is $273.68 a month. Compare the following—these men working 12 hours per day.

Classification	Rate per Hour	Salary per Month
Enginehouse foreman	..	$273.68
Machinist helper	58	243.00
Unskilled mechanic	70	294.00
Machinist, minimum rate	77	323.40
Machinist, maximum rate	90	378.00

A USE FOR EVERYTHING.—Bullet-proof trains are constructed in Central America by putting old telephone directories between the two sheets of steel which ordinarily form the car sides. Although the cars were built of double steel plates, these had been penetrated by the high-powered bullets fired by bandits who frequently attack the trains. Someone discovered that when telephone books were placed between the plates, the bullets did not come through. Thereupon, an order was placed for 4,000 lb. of old New York telephone books.

Heat Transmission in Locomotive Boilers

Part III

By H. S. Vincent*

In the first section of this article, which appeared in the May issue of the Railway Mechanical Engineer, Mr. Vincent reviewed the Coatesville test of 1912 and subsequent locomotive laboratory tests. Available test data were tabulated and detailed explanations of these data were given. The second section, which appeared in the June issue, was devoted to a discussion of the tabulated data which discussion was not completed. No installment was included in the July issue.

Conclusion of a study as to the relative value of heating surfaces in firebox, tubes and flues and in superheaters

Further Discussion of Tabulated Data

24—The percentage of the total heat transferred over the firebox, tube and superheater surfaces, respectively, as shown in columns 11a, 12a and 13a, of Tables 10—18, has been plotted in relation to the total weight of gas per sfg/hr. flowing through the boiler. Figs. 7—7G, show these relations. It is evident from the plots that the heat transferred varies in a straight line relation with the gas flow. In nearly every instance, the heat transferred over the heating surfaces of stayed fireboxes decreases with increasing gas flow, while that transferred over the tube and superheater surfaces increases as the gas flow. The single exception is the syphon equipped boiler, for which other laws govern. In the water-tube firebox, the normal trend is reversed for firebox and tubes.

It is clearly shown, from the evidence presented, that the weight of gas flowing over the heating surfaces is the all-important factor in the distribution of work between firebox and tubes. When the gas flow is augmented, the tube transfer increases in conformity with well known laws of heat transmission. In the firebox, the heat transferred appears to bear an inverse relation to the speed of the gases. In other words, the longer the charge of gas remains in the firebox, the greater is the heat transfer.

The effect of placing additional heating surface in the firebox, located in the gas stream, is shown on Figs. 7D and 7E, representing respectively, the Illinois Central boiler with and without syphons. When syphons are added, the trend of tube transfer is reversed, the firebox transfer becoming almost constant at all rates of gas flow.

It is evident that when syphons are added to a firebox a very considerable portion of the heat is transferred by convection. This is because the walls of the syphons are disposed in such a manner that the gases which otherwise do not reach the firebox heating surface are, with the syphons, divided into thin streams having rapid motion, a condition conducive to high heat transfer by convection. The temperature in the front of the syphon-equipped firebox was approximately 300 deg. F. lower than in the non-syphon equipped boiler which lends confirmation to this theory.

It is of interest to note the constancy of the heat transfer over the superheating surfaces, regardless of the variations which are coincidently occurring in the surrounding tubular surfaces. It would appear that, for the two boilers equipped with Type E superheaters, the increase in heat transfer with gas flow is somewhat less than with the Type A heater. The evidence, however, is too meagre to warrant any definite conclusion.

25—The allocation of the heat transferred in the boiler to its component surfaces gives important evidence as to the value of the coefficient of heat transmission. Average values of this coefficient are given in columns 17a, 18a and 19a, of Tables 10—18. Equations (5), (6) and (7), indicate how these data were derived.

In Figs. 8—8G, inclusive, the values of the coefficients are plotted in relation to the fuel burned per sfg/hr. and a smooth curve is drawn indicating the trend of the data. Attention is particularly directed to Figs. 8D—8G, inclusive, representing the boilers without combustion chambers. In these boilers the coefficient of transmission k_f, through the firebox walls, increases rapidly in relation to the fuel actually burned. Between the rates of 40 and 80 lb. per sfg/hr. the increase in transmission ranges between 40 and 70 per cent. Figs. 8—8A illustrate the effect on firebox transmission of lengthening the combustion chamber. It is also worthy of note that the coefficient k_S equals or exceeds k_t in all but one of the stayed fireboxes.

It is evident that the high value of k_f, as compared with k_t and k_S, is due, in large part, to the heat transferred by radiation from the firebed and flaming gases. It is probably true that only a relatively thin envelope of the gases ever touch the firebox sheets, especially at high rates of energy liberation. At the rear end of the arch where the gases are crowded between it and the crown sheet, the rate of transfer is probably greater.

The flow of water over the firebox surfaces, is probably no more rapid than over the tube surfaces, consequently, the coefficient of transmission by convection is about equal for the same temperature difference and speed of gas flow.

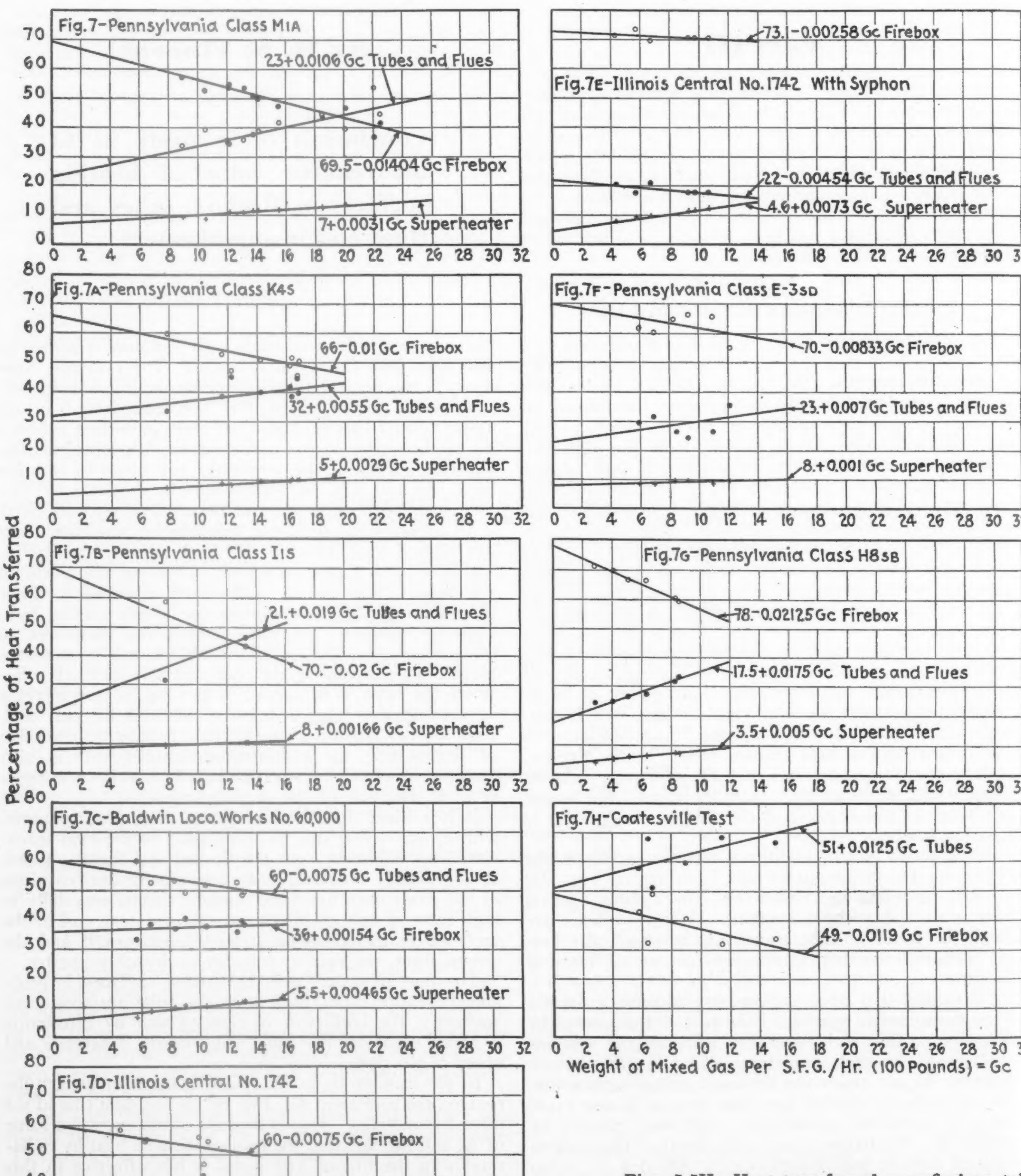
In the case of B. L. W. No. 60,000 with water-tube firebox, the coefficient K , Fig. 8C, is less than that of the other locomotives. This is because of the excessive value of R, and the fact that the transmission of heat by radiation from the firebed and gases is less effective in this type of firebox. The firebox heating surface of No. 60,000, from which the value of $R = 9.36$ is derived, comprises the total surface of all the water-tubes and drums which surround the firebox, amounting with the arch tubes to 772 sq. ft. If the projected area of the interior of the firebox were used, the heating surface,

* Formerly chief consulting engineer, Franklin Railway Supply Co.

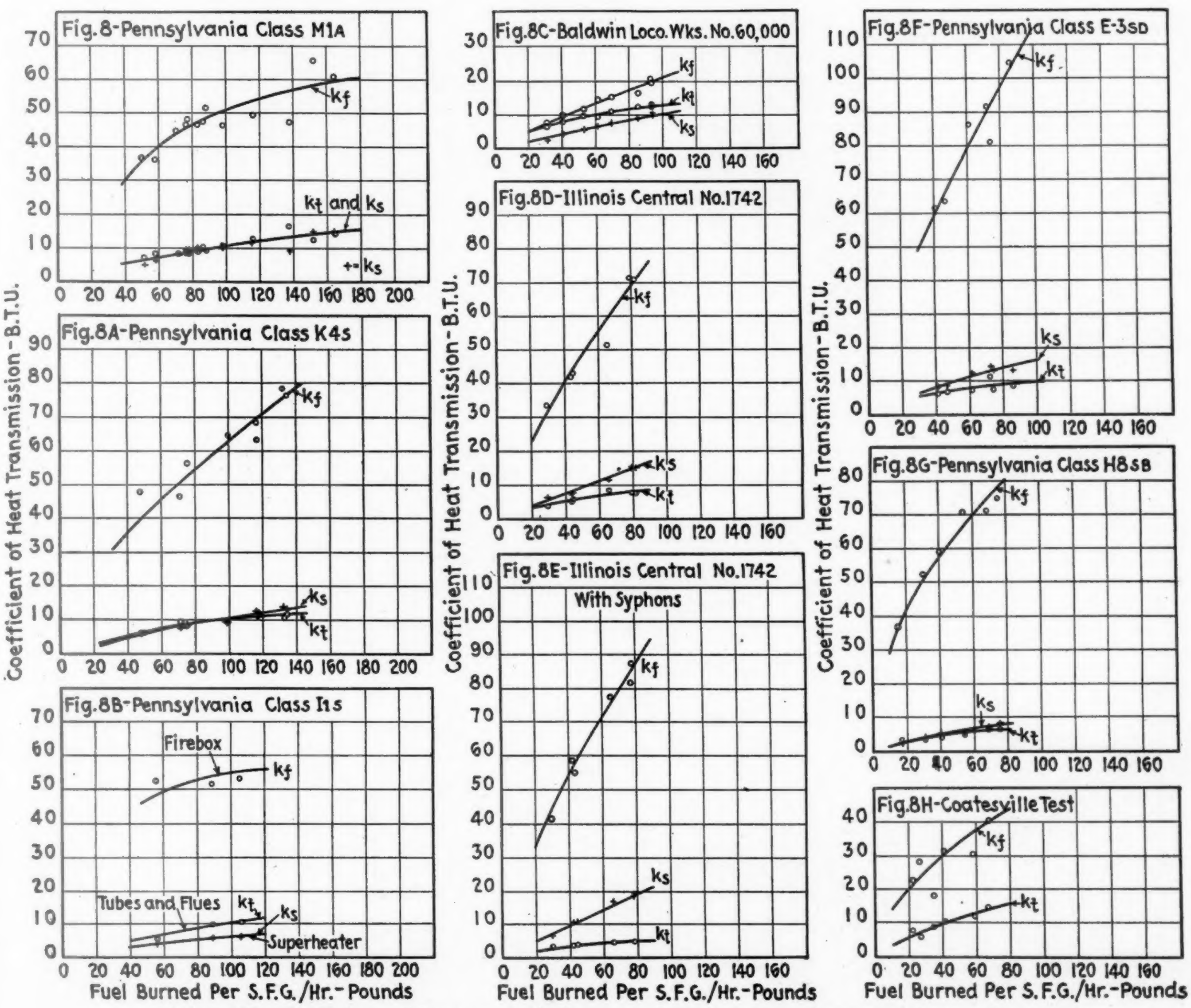
including arch tubes, would be reduced to 342 sq. ft., giving a value of $R = 4.14$. By multiplying columns 14a and 17a, Table 13, by 2.26, the corresponding values for the projected area of firebox may be determined.

The Coatesville Test

26—Attention has been directed to the source of the data on which the Cole design ratios were largely based. In Tables 9 and 18, this data for the radial stayed



Figs. 7-7H—Heat transferred over firebox, tube and superheater surfaces in percentage of total heat transfer



Figs. 8-8H—Coefficient of heat transmission over firebox, tube and superheating surfaces

boiler is assembled in the same manner as described for Tables 1—8 and 10—17. The heat transferred over firebox and tube heating surfaces has been taken directly from the test record of evaporation and five per cent added for external radiation.

The temperatures, shown in columns 4a, 5a and 6a, have been calculated from the evaporative data as firebox temperatures were not taken in the test. The per cent of heat transferred over firebox and tube surfaces, as shown in columns 11a and 12a, is plotted in Fig. 7H, in relation to the gas flow. The general trend of the data is similar to that of the other stayed firebox boilers discussed.

In Fig. 6H, the evaporation of firebox and tubes as related to the dry fuel fired per sfg/hr. is shown. It will be observed that in this boiler the tube evaporation greatly exceeds that of the firebox, completely reversing the order found in the other examples cited.

There are at least two reasons why the Coatesville test is not typical or representative of present-day locomotive operation; (a) the boiler was not equipped with a brick arch at the time of the test, consequently the gases were short-circuited to the tubes, reducing the normal transfer in the firebox, both by convection and flame radiation. In a test of the Pennsylvania Mikado*, 5000 class, with and without an arch, it was found that there was a difference in evaporation per pound of fuel, of 6.7 per cent at a firing rate of 80 lb., per sfg/hr. and 18 per cent at a firing rate of 150 lb. in favor of the arch, (b) the firebox was isolated from the tubular compartment, consequently, there was no horizontal circulation of water across the firebox surfaces. The movement of the water in a normal boiler is an important factor in promoting heat transfer. This fact offers an explanation of the low rate of heat transfer which characterizes the tubular fireboxes of stationary boilers as well as of locomotives.

After the Coatesville boiler had been restored to its normal condition, a test was made by the late George L. Fowler to determine the movement of water along the firebox sides. Quoting from his report, "there is a regular slow movement from front to back, broken throughout the whole course by violent agitation and innumerable cross currents."

General Discussion

27—Wohlenberg[6], by strict mathematical analysis evolved a coefficient for the fraction of liberated energy which is absorbed in the furnace of a stationary boiler, when the rate of fuel consumption fuel characteristics

* Pennsylvania Bulletin No. 30.

[6] A. S. M. E. Proceedings 1925 and 1926.

and excess air supply are known. Having the fundamentals, it is necessary to solve for a mean flame temperature that will balance the equation. This analysis, as worked out by Wohlenberg, applies strictly to a firebox of cubical form. Its application to a locomotive boiler involves unknown factors, because of the peculiar shape. Until more accurate data are available as to the effect of radiation on such an involved form as the locomotive firebox, the writer believes that the empirical method of approach will yield better results.

The percentage of heat absorbed in the firebox, as related to the ratio between available heat and firebox heating surface, for all of the locomotive boilers herein discussed, is shown in Fig. 9. A curve is also given for Wohlenberg's coefficient applying to the cubical furnace of a stationary boiler having water walls and using pulverized coal with 30 per cent excess air. A curve representing eight tests cited by Orrok[7], made on large stationary boilers is also shown in Fig. 9.

The locomotive curves have similar characteristics, with exception of B.L.W. No. 60,000 and Illinois Central with syphon. It will be seen that there is a remarkable correspondence between the curves for the Pennsylvania Classes M1a, and I1s, although the fireboxes are of very dissimilar design. These locomotives are equipped with the Type E superheater, all others cited in this discussion have the Type A superheater.

As the ratio of heat liberation decreases, the fraction of total heat absorbed in the firebox becomes greater. The trend of the curves indicate that at very high rates of combustion the fraction of heat absorbed in the firebox tends to become constant.

The locus of the curve representing the Coatesville test is well below the position it should assume by virtue of its heating surface ratio.

28—As further evidence of the relative constancy of

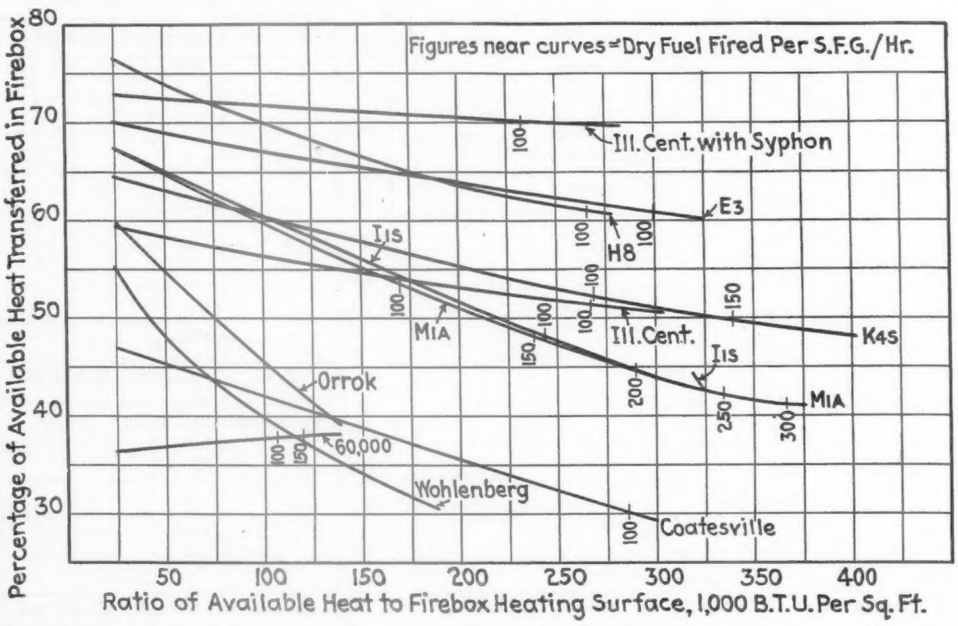


Fig. 9—Percentage of heat transferred in the firebox as related to the ratio between available heat and firebox heating surface or column 11/R

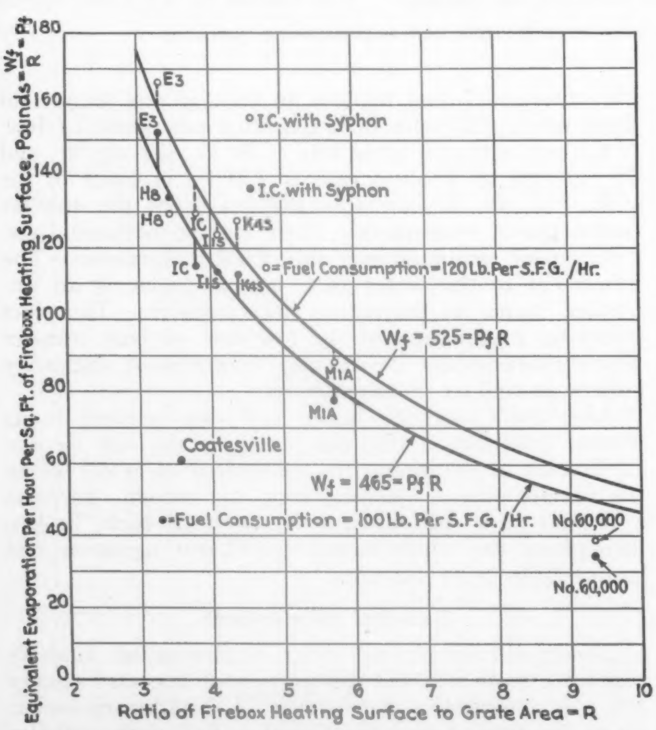


Fig. 10—Equivalent evaporation per square foot of firebox heating surface as related to the ratio R

the relation $Wf = PfR$, in a stayed firebox of normal design, two values of this relation are shown in Fig. 10, for fuel consumption rates of 100 lb. and 120 lb. per sfg/hr. The actual values of Pf, as determined from the test data are indicated and curves are constructed to equation;—

$$Wf = PfR \qquad (20)$$

in which

Pf = equivalent evaporation per hour per square foot of firebox heating surface

The coefficient Wf will vary with each change in rate of fuel fired. It will be observed that for most of the tests the value $Wf = 465$ represents closely the actual values of Pf for a fuel consumption of 100 lb. per sfg/hr.; likewise, the coefficient $Wf = 525$ is reasonably representative of the values of Pf for a fuel consumption of 120 lb. per sfg/hr. The only exception in the fireboxes of normal construction is Pennsylvania Class H8. We have noted from Fig. 6G that the firebox of this locomotive reached its maximum evaporation at a firing rate of 101 lb. per sfg/hr.; consequently, for any higher firing rate, the value of Wf will have decreased as is indicated in Fig. 10.

The writer believes that this exhibit clearly proves a definite relation between Pf and R at any firing rate up to $.8Gw\ max$. Because of the change in the shape of

[7] A. S. M. E. Proceedings, 1925.

the evaporative curve as it approaches its maximum (see Fig. 6G) the equation $Wf = PfR$ is not valid beyond $.8Gw$ *max*.

Among the implications involved in this assumption, the most important is that all firebox heating surface is not of equal value in heat transmission. Class M1a, with a ratio of $R = 5.71$ is, because of its 98-in. combustion chamber, a less efficient evaporator per unit of surface than classes K4s, and I1s, with shorter combustion chambers but otherwise similar in design. Classes E3, and H8, with no combustion chamber, are still more efficient per unit of surface. The curve also implies that the data derived from temperature relations is reasonably consistent.

As indicated in paragraph 23, the firebox evaporation of Class E3, as estimated from the tube temperature, is thought to be too high. The curves in Fig. 10 give evidence as to the correctness of this assumption and show the position the E3 should take, which is near that of Class H8.

The evaporative rate of B.L.W. No. 60,000, falls below the normal rate for a stayed firebox having an equal value of R.

29—The relation between tube and flue evaporation, Pt and the ratio R_1, is more involved, as indicated by Fig. 11. Here, the length, diameter and arrangement of tubes and flues enter the problem.

It appears that for any related grouping of these variables, Wt can be expressed by the equation;—

$$Wt = PtR_1 \qquad (21)$$

in which

Pt = equivalent evaporation per hour per square foot of tube and flue heating surface

Values of Wt, for firing rate of 100 lb. per sfg/hr. are indicated in Fig. 11. The boilers under discussion fall normally into three groups. As might be expected, Classes E3, and H8, with short tubes of the same length, can be ranged together, coming under an average value of Wt=242. The Pennsylvania Classes M1a, and I1s, with similar tube arrangement and length and the Illinois Central non-syphon, having the unusual combination of 2-in. tubes, 246 in. long fall together under a value of $Wt = 308$. Pennsylvania Class K4s, and B.L.W. No. 60,000, with unequal tube length, but both arranged for Type A superheater, take a value of $Wt = 412$.

It is evident that we do not have sufficient data to reach a definite conclusion as to the proper value of Wt for any given combination of tube size, length and arrangement. The method herein proposed offers a logical means of acquiring the desired data.

As a check on the correctness of the evaporative rates shown in Fig. 11, they will be compared with Test No.

Table of Symbols

Ratios
- R —Firebox heating surface to grate area
- R_1 —Tube and flue heating surface to grate area
- R^2 —Superheating surface to grate area
- R_o —Grate area (sq. ft)

Evaporation and Efficiency
- W —Evaporation of boiler—total per hour
- W_f —Evaporation of firebox per hour
- W_t —Evaporation of tubes and flues per hour
- W_s —Evaporation of superheater per hour (equivalent)
- u = B.t.u. required to produce 1 lb. steam from feedwater
- k —Coefficient of heat transmission
- k_f —Coefficient of heat transmission, firebox
- k_t —Coefficient of heat transmission, tubes and flues
- k_s —Coefficient of heat transmission, superheater
- F —Evaporative efficiency of total boiler
- F_f —Evaporative efficiency of firebox
- F_t —Evaporative efficiency of tubes and flues
- F_s —Evaporative efficiency of superheater
- F_v —Per cent of available heat transferred over total heating surface
- $y = K/u$
- $Y = KR_o/u$
- m and n constants—varying with boiler design and fuel characteristics
- P_f —Equivalent evaporation—per sq.ft. per hr.—firebox heating surface
- P_t —Equivalent evaporation—per sq.ft. per hr.—tubes and flues, heating surface
- P_s —Equivalent evaporation—per sq.ft. per hr.—superheater heating surface

Temperatures
- t —temperature of gas
- t_w—temperature of saturated steam in boiler
- t_s —temperature of superheated steam in branch pipes
- a —temperature at fire bed—tw
- b —temperature at tube entrance—tw
- c —temperature in smokebox—tw

Combustion
- G —Weight dry fuel fired per sq.ft.grate per hour
- G_c —Weight gas over heating surfaces per sq.ft.grate per hour
- G_w max.—Firing rate per sq.ft.grate per hour at max evaporation
- e, f, g—Constants varying with boiler design and fuel characteristics
- C_g —Weight of gas per lb. coal burned
- C_b —Ratio coal burned to dry coal fired
- C_p —Mean specific heat of mixed gases at constant press. between 0 deg. to t deg. F.
- K —Calorific value—dry fuel—B.t.u. per lb.

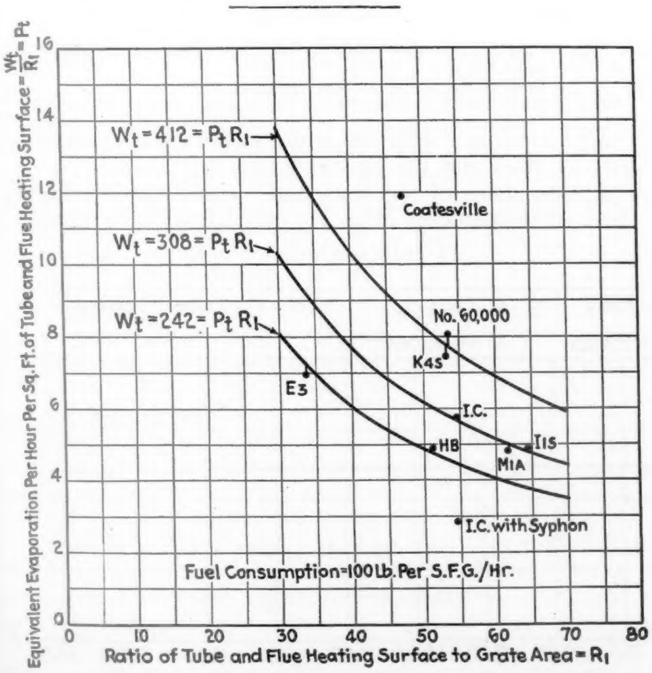


Fig. 11—Equivalent evaporation per square foot of tube and flue heating surface as related to the ratio R_1

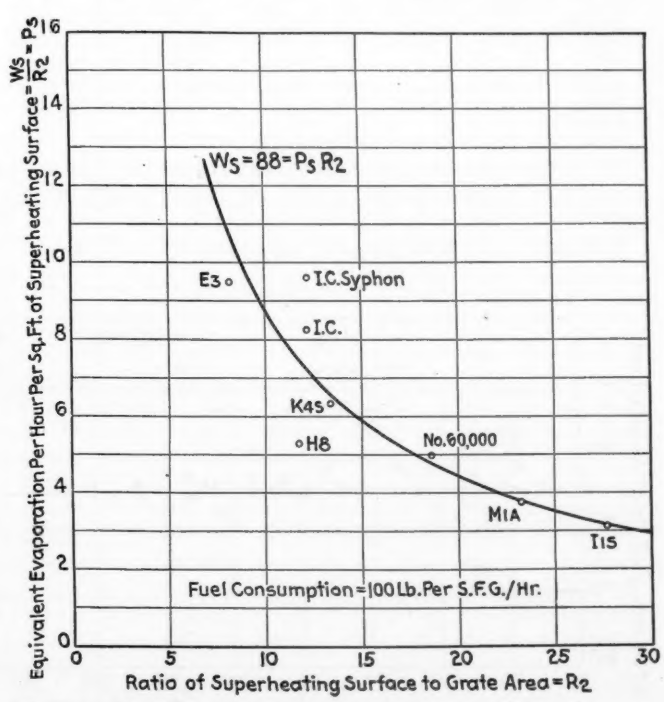


Fig. 12—Equivalent evaporation per square foot of superheating surface as related to the ratio R_2

3217, Class H8, run at a firing rate of 113 3 lb. per sfg/hr. From temperature readings taken in the flues, the evaporative rate can be calculated ;—

Temperature in flue, firebox end	1925 deg. F.
Temperature in flue, smokebox end	690 deg. F.
Difference in sensible heat between firebox and smokebox end.	345.3 B.t.u.
Weight of gas per hour passing through one flue	598.0 lb.
B.t.u. transferred in flue per hr. to water and steam = 598 × 345.3	206,700 B.t.u.
B.t.u. transferred per hr. over superheating surface, one flue.	97,300 B.t.u.
B.t.u. transferred per hr. over water heating surface, one flue.	109,400 B.t.u.
Water heating surface per flue	20.99 sq. ft.
Equivalent evaporation per hr. per sq. ft. of flue heating surface = 109,400/20.99 × 970 × 105 =	5.12 lb.

This is 105 per cent of the rate shown in Fig. 11, derived by a different method. The gas flow for Class H8, is somewhat below normal but this accounts for only a small percentage of the discrepancy between the actual evaporation and that contemplated in the Cole tables.

By a similar calculation it will be found that Test No. 3109, Class E3, at a firing rate of 104.3 lb. developed a value of P_t, = 6.22 for the flues and $P_t = 7.35$ for the tubes, or a mean value for tubes and flues of P_t, = 6.83. This is 95 per cent of the rate given by the equation $P_t = 242/R_1$.

The value of Pt, shown in Fig. 11, for the boilers having flue arrangement for Type E superheaters, are lower than for the Type A, arrangement. The effect of this is offset by the increased evaporative surface—from 10 to 12 per cent—which may be secured with the Type E arrangement in boilers of similar dimensions.

Table 22—Comparison of Actual Evaporative Rates with Cole Factors, at Fuel Consumption of 100 lb. per SFG/Hr.

Class of Locomotive 1	Equivalent evaporation per sq.ft. of firebox heating surface, pounds per hour 2	Column 2 divided by factor of evaporation 3	Cole firebox factor, lb. per sq.ft. per hour 4	Equivalent evaporation, tubes, flues and superheater per sq.ft. of tube and flue heating surface lb. per hour 5	Column 5, divided by factor of evaporation 6	Cole factor lb. per sq. ft. per hour Tubes 7	Cole factor lb. per sq. ft. per hour Flues 8
M1a	77.0	57.9	55	6.25	4.62	8.73	9.50
K4s	116.0	87.5	55	8.92	6.73	8.73	10.17
I1s	113.0	87.6	55	6.20	4.77	8.73	9.50
60,000 ..	34.1	26.2	..	9.75	7.50	8.20	9.18
1742	115.0	87.0	55	7.57	5.72	8.55	9.86
1742 syphon.	136.5	103.2	55	4.99	3.78	8.55	9.86
E3sd ...	152.0	114.7	55	9.28	7.00	9.44	11.53
H8sb ...	134.0	101.1	55	6.09	4.60	9.97	11.65
Coatesville test ...	62.9	52.2	55	11.88	9.85	9.66	....

The factors in column 8, for flues, Classes M1a, and I1s, were not included in the original Cole tables. These are taken from tables published by Dr. A. I. Lipetz.* and apply to boilers equipped with Type E superheater.

* Transactions A.S.M.E., Railroads, Vol. 55, No. 9.

30—The relation between the heat transferred over the superheater, in terms of equivalent evaporation per square foot of superheating surface, and the ratio R_2, for the boilers under discussion, is shown in Fig. 12. The curve drawn through the plotted positions, in accordance with the equation $W_S = P_S R_2$, indicates that, regardless of design of boiler or superheater, there is a relatively constant relation between P_S and R_2. Nevertheless, the value of improvement in superheater design is indicated by the position of the plotted points in relation to the curve.

31—As previously mentioned, the Cole factors were primarily based on the Coatesville test, but the author also utilized the experiments made at Altoona with tube and flue temperature. Strictly speaking, the Cole factors apply only to the heat transferred to the water, at a temperature corresponding to the boiler pressure. Subsequently it became the practice to assume that these factors also include the heat transferred over the superheater. This is probably the source of some of the error which has arisen in applying them to modern boilers with high superheat.

A comparison is given in Table 22 between the evaporation per square foot of firebox and tubular heating surface as derived by the method discussed herein, and the unit evaporative rates as given in the Cole tables for the various locomotives under consideration. The Cole tables are based on actual evaporation; that is, steam at branch-pipe pressure and temperatures, from water at feedwater temperature. Therefore, for the firebox it is necessary to divide the evaporative rates shown in column 2, Table 22, by the appropriate factor of evaporation to get the actual evaporative rates, column 3, which are comparable with the Cole rates shown in column 4. The same method is used in comparing column 6 with the Cole rate for tubes and flues, columns 7 and 8.

The factor of evaporation as here used is the ratio of the heat required to generate one pound of steam under actual conditions of pressure and temperature, to that required to generate one pound of steam "from and at 212 deg. F."

$$\text{Factor of evaporation} = (H - h)/970.2$$

in which

H = total heat in one pound of steam at boiler pressure and steam temperature
h = heat of the liquid at feed temperature
970.2 = latent heat of evaporation of one pound of steam at 212 deg. F.

In accordance with the usual custom the fraction has been omitted and the figure 970 used.

32—In three of the tests under consideration, namely those of locomotives M1a, I1s and H8sb, as indicated by

(*Continued on page 343*)

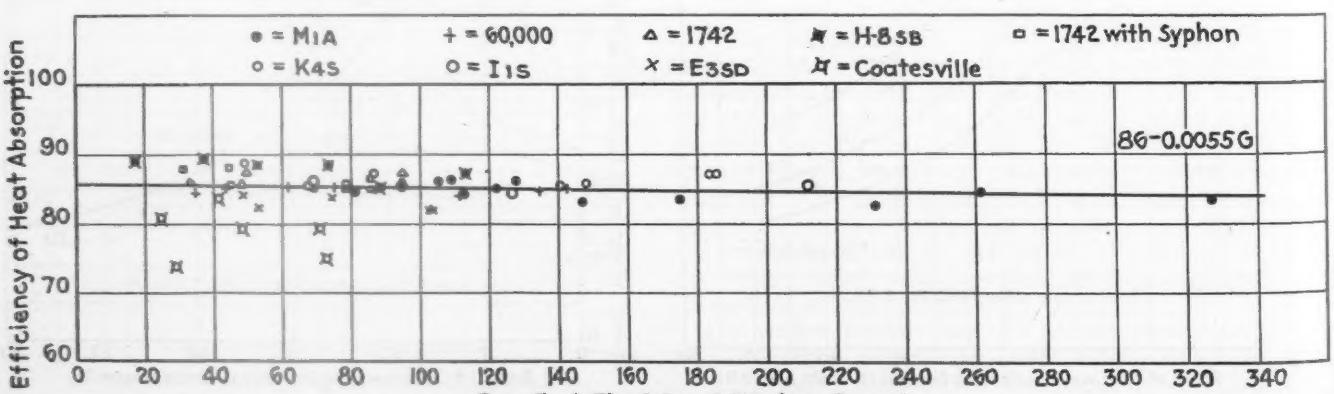


Fig. 13—Heat absorbed by boiler heating surfaces in percentage of heat available for absorption

Air Brakes and Entomology

Two species of wasps illustrating relative difference in size

The wasp, of the mud dauber variety, is a source of danger because of interference with air brake operation. Problem necessitates thorough study and research

By C. D. Stewart*

IN many respects the two subjects, air brakes and entomology, are very far apart, but of late years certain insects have manifested an interest in some air brake devices to the extent that man in turn must become interested in this insect life to the end that he may keep their activities from becoming harmful.

Someone has said that if man were not the dominant animal, this would be the age of insects. They outnumber all other groups of animals combined and show a wealth of individualism. The amazing variety and specialization of habit, the extraordinary adaptation and shifts for living which insects show lead men to ponder on the ways of nature.

The Mud Dauber

Scientists tell us that our next great war will be against insects, and already we are having skirmishes with the enemy along numerous fronts. Furthermore, as in wars between nations, all is not spectacular bombardment and wholesale destruction. Some insects in their struggle for existence do not create the devastation that accompanies the marching armies of locusts, grasshoppers or termites, but their activities are most annoying to man to say the least. In this latter classification we can place the so-called mud dauber, or wasp.

His offense against mankind lies solely in the fact that in creating a suitable environment for the rearing of his off-spring, he at times selects a spot that was designed by man for an entirely different purpose. Those familiar with the functioning of air brake mechanism are aware of the necessity for passages leading to the atmosphere for the escape of air. These passages are in some instances well suited to the needs of the mud dauber, but if they are stopped up by its nests the apparatus may fail to function.

Wasp Excluder

The obvious method of procedure in discouraging this lady (for the female is the offender) in the exercise of her home-making instinct is to provide a passage that she cannot enter. This is possible in some instances, and has been done where practical. As an illustration, it is now the practice to install in the brake cylinder exhaust port of existing air brake apparatus a screened fitting known as a "wasp excluder." This fitting must have an opening equivalent to the 3/8 in. port that it is protecting. Fortunately, it does not affect the efficiency of the functioning of the devices if the opening is divided into several apertures too small for the passage of the wasps.

Incidentally, in the design of the screen, the net size of the opening is not the only requisite. Another very important factor which must be borne in mind is that a series of small openings is more readily obstructed by freezing moisture than one large opening, so that careful consideration must be given to the arrangement as well as the shape of the group of openings. Still another problem that has proven more serious than anticipated is the theft of these fittings. Although a bushel basket of them would have no real value, nevertheless, they seem to intrigue the brake rod riding clientele of our railroads, and this fact must be taken into account.

Do Wasps Have Pet Aversions?

Modern conditions have added another complexity to the problem in that in the new air brake equipments, there are now required more and in some cases larger exhaust openings in which nothing must be placed that will affect the free passage of air, or that will in any way contribute to the stoppage of the passage from any source, if the integrity of the brake is to be preserved. With this in mind, a study is being conducted into the habits of the mud daubers to learn, if possible, if there are any conditions that may be set up that will discourage their activities. Human beings have their likes and dislikes, and it seems reasonable to suppose that mud daubers also have their pet aversion.

Test blocks with openings of every conceivable shape have been devised and set up in various parts of the country. Holes ranging in size from .056 in. to .75 in. in diameter have been drilled in various manners, such as horizontally, at angles sloping upward and downward, and some with right angle bends that would tend to make the interior recesses dark, all with the thought of learning if there are any conditions that are repugnant to these fellows. Observations of these blocks at frequent intervals reveal that the insects do select certain types of openings more readily than others, but when the more desirable locations have been taken up, the late comers seem to be content with second and even third choice, and soon all available openings within a rather large range have been appropriated.

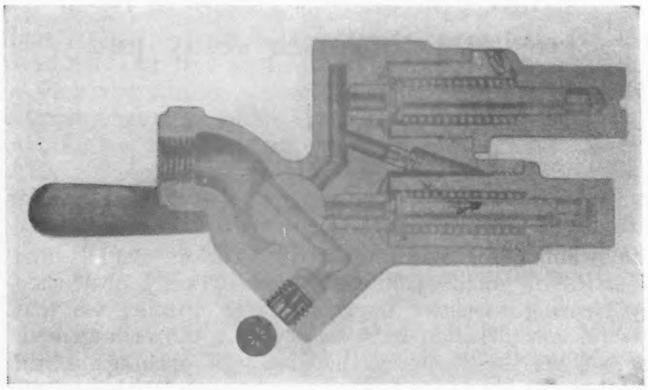
With the information available up to the present time, therefore, it seems that the only discouraging element is size of aperture, and unfortunately the size is either larger or smaller than is convenient in air brake design. Furthermore, it is possible that large openings may be filled by other species, as there are some 10,000 species of wasps, and the variation in size covers a considerable range.

Wide Variety of Habits and Characteristics

For those who take their entomology seriously it

* Chief Engineer, Westinghouse Air Brake Company.

would not do to leave the impression that mud dauber is the name these insects respond to within their own circles. The small variety which frequents the southwestern portion of the United States is Trypoxilon Arizonese Fox, being attractively striped red and black. The intermediate size relative, striped yellow and black, is Sceliphron Caementarium Drury, and is more widely distributed. The Primo Carnera of the tribe, green in color, is Chlorion (Chlorion) Cyaneum Dahl. His feet

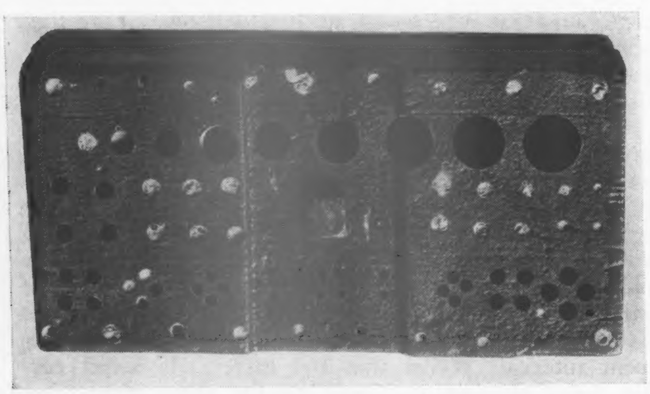


Wasp excluder in brake cylinder exhaust port

alone would get stuck in the opening that the Trypoxilon uses for a home.

As a matter of fact, the term "mud dauber" must be resented by some of the tribe, because there are varieties that use nothing but petals of flowers with which to build their nests and seal in the food for the larva of the next generation. These different characteristics of the several species have led to referring to them as the mason wasp, the carpenter, the tailor and the miner.

Anyone who has in mind undertaking to provide some means for keeping these ladies where they belong should not take them too lightly. A fairly brief study of their history and present life will not only be exceedingly

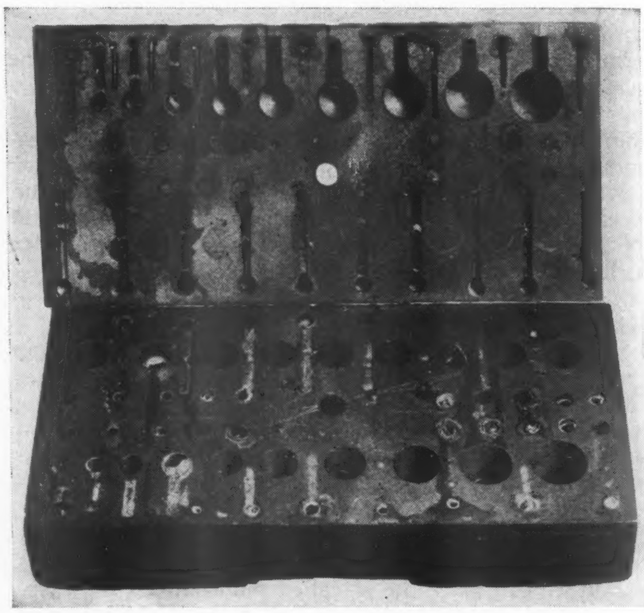


Test block is so constructed that it can be opened up to give a view of all passages with minimum disturbance of mud daubers' nests

fascinating, but increase very materially one's respect for their talents. It seems appropriate, therefore, to briefly touch on some of their activities and indicate where this subject can be pursued to any length desired.*

Entomologists have classified animals that have three pairs of legs, insects, and insects in turn are divided into orders, superfamilies, families, subfamilies, genus and species. Now, because of many common characteristics the wasp is grouped with ants and bees under the order Hymenoptera. Individual characteristics in appearance and behavior allocate these in turn into the various subdivisions and species, and it is with relatively few of the ten thousand species in which we are interested in connection with our prevent problem. These particular species are referred to as solitary wasps because they usually shift for themselves, as contrasted with the bee and yellow jacket termed "Social Hymenoptera," which divide their activities among workers, drones and queens. The solitary wasps are in physical structure the most superbly specialized of insects. Their unusual physical endowment is correlated with extraordinary industry and behavior, having perhaps the greatest range of activity of any of the insects.

The ancestry presents an interesting study, since the group appears to have been fully developed in the lower tertiary age, as is deduced from a study of the fossils found in the Baltic amber of that age. Unquestionably, therefore, their evolution has extended over a period of four to six million years. It is not so surprising therefore, to find that they exhibit such a diversity of habits, especially when we remember the whole mammalian class, man included, has had a shorter evolution.



Test block opened up and showing wasps' nests in different sizes and types of holes

By way of illustrating the claim of intelligence, sometimes referred to as "instinct," let us briefly note the skill employed in providing for the continuation of the race based on the observations of Faber, conceded to be one of the world's greatest entomological observers, and I suggest that anyone will be intensely entertained in reading the complete volumes of Faber's accounts in more or less story form of the life of the wasp.

Life Cycle of Mud Dauber

There are several species of wasps that are mud daubers and the study of any particular one will serve to teach something of their habits. The life cycle of this insect includes the egg, the larva, the pupa and the wasp. After the female wasp has laid the egg, the larva on hatching must shift for itself, but in order to reduce the uncertainty as much as possible the mother provides the first few days' food. With the wasp in which we are interested, this food invariably consists of a spider, and in order that this food may be in suitable condition when it is required the wasp exercises the first one of its remarkable instincts.

* J. H. Fabre—Hunting Wasps. V. L. Kellog—Insects. J. H. Comstock—Introduction of Entomology. P. Rau—Wasp Studies Afield.

Instead of killing the spider, which would mean that it would be spoiled before the lava was hatched, the wasp administers an anæsthetic by a sting most scientifically placed. An anatomical study of a spider reveals that this sting to be effective without causing death must be placed with absolute precision. The spider is then completely inert, but will remain alive for many days.

After the spider has been placed in the nest the wasp is called upon for its second remarkable performance. The egg must be laid at a specific point on the body of the spider, following which the nest is then sealed and the mother wasp leaves, nevermore to return. After a period of days the larva is hatched and immediately begins to devour the spider in order that it may acquire the strength and materials for the cocoon it will shortly build. At this stage this new-born larva, with no endowment other than instinct accumulated through the centuries, eats its way into the spider's body in such a manner that although the process extends over a number of days, life remains in the spider until the last day.

This remarkable feat is made possible, first by the precise location of the egg by the mother, and second, by the unerring instinct of the larva to skillfully avoid all vital organs until the last. On completing the last vestige of the spider, the larva is then ready to weave its own shroud skillfully compounded of silk, glue and sand. From this cocoon it later emerges as a wasp and coming out of the nest prepared by its mother it emerges into the world ready to repeat this phenomenal cycle.

We have spoken only of the trouble these wasps cause mankind and it would not be fair to omit some reference to the good they do. Only recently the Department of Agriculture sent 40,000 wasps by air plane from Morristown, N. J., to Pacific Coast states to make war on an infinitely worse insect enemy of man—the coddling moth. The particular specie of wasp that was shipped deposits its egg on the moth while in the grub state, instead of the spider which is used by some other species. It is hoped by means of these wasps shortly to take out of circulation sufficient coddling moths to prevent the destruction of the apple orchards of the West.

Heat Transmission in Boilers

(*Continued from page 340*)

Table 23, the firebox reached its limit of evaporation within the range of firing. It must not be assumed that this is because of inability of the metal surfaces to transmit a greater quantity of heat. In every case the heat transfer was limited by an excessive amount of unburned fuel. There is no indication that the heating surface had reached its limit of absorption in any of the boilers under consideration. Table 23, shows that the locomotive equipped with syphons would, if worked to capacity, have developed an average heat transfer in the firebox of 217,000 B.t.u. per hour, per square foot of heating surface. Column 5, of Table 23, indicates a relation between the heat absorbed in the firebox and the percentage of the fuel actually burned.

33—The heat absorbed by a boiler bears almost a constant relation to the heat available for absorption, regardless of peculiarities of design. In Fig. 13, the efficiency of heat absorption is plotted in relation to the dry fuel fired per sfg/hr. The percentages shown by the vertical scale are derived from Tables 1-10, by dividing column 13 by column 11, and multiplying the quotient by 100. With exception of the Coatesville test, a curve through the plotted points to equation;

$$F_V = 86 - 0.0055G \qquad (22)$$

in which

F_V = percentage of available heat transferred over total heating surface.

very closely represents the remaining 56 tests. The location of the plots for the Coatesville test offers additional evidence that it was sub-normal.

34—Finally, it has been shown by Figs. 10, 11 and 12, that the heat transferred over the firebox, tube and superheating surfaces is inversely proportional to the ratio between the respective heating surfaces and the grate area. This is equivalent to saying that *the heat transferred to the water and steam in a locomotive boiler is, within practicable limits, independent of the area of the heating surface and varies solely as the quantity of heat available for transmission.*

Table 23—Maximum Heat Transfer in Firebox

1 Class of Locomotive	2 Ratio of firebox heating surface to grate area = R	3 Maximum heat transfer developed in test, from curve Wf, at highest range of firing. B.t.u. per sq.ft. per hour	4 Maximum heat transfer from equation Gwfmax. = mf/2nf. B.t.u. per sq.ft. per hour	5 Coal burned per cent of coal fired, at firing rate of 100 lb. per sfg/hr.
Penna. M1a	5.71	107,000	117,800	73.6
Penna. K4s	4.38	157,600	162.700	88.5
Penna. I1s	4.10	108,900	126,400	75.5
B.L.W. 60000	9.36	42,400	52,700	76.5
I.C. 1742	3.79	107,700	155,000	84.5
I.C. 1742*	4.57	116,000	217,000	90.0
Penna. E3sd	3.28	151,000	174,000	77.5
Penna. H8sb	3.43	127,700	129,700	70.5
Coatesville	3.56	57,500	61,100	86.5

* Equipped with syphon.

In relation to the firing rate, the unavailable heat increases more rapidly than the available, causing the boiler to reach a limit of evaporation. Consequently, the prime considerations in the design of a locomotive boiler are (a) grate area, and (b) weight of fuel fired per unit of the time and area (lb. per sfg/hr.). For both, sustained capacity and thermal efficiency (a), should be as large and (b), as small as practicable within the limits set for the designer.

As a correlary to this conclusion it must be said that a boiler can not be satisfactorily designed or rated on the basis of heating surface alone without first relating this surface to the area of grate and rate of firing.

35—There may be some criticism of the method used in this analysis on account of the assumption that the gases in the firebox have the same composition as is shown by the smokebox analysis. The writer admits that the gases near the grate may not be correctly represented by the smokebox analysis, but is of the opinion that the gases near the tube sheet have approximately the same composition as in the smokebox. The heat in the gases at the firebed has been used in this study only for calculating the quantity *kf*. All of the remaining analysis is based solely on the heat content of the gases at the tube sheet.

The author desires to acknowledge the assistance rendered him in the preparation of this article by the test plant bulletins of the Pennsylvania Railroad and the University of Illinois; publications of the Baldwin Locomotive Works, American Locomotive Company, Lukens Steel Company, and others.

Locomotive Weight Distribution And Center of Gravity*

IN order to determine the weight distribution of a locomotive, by which is meant the weight at the rail under each pair of wheels, it is necessary to have the following information:

1—Complete total weight of locomotive (without tender)
2—Dead weights
3—Longitudinal center of gravity
4—Proportion of spring rigging and equalizers, either from drawings or by actual measurements.

The total weight of the locomotive can be obtained on any railroad or builder's scales which have sufficient capacity. If locomotive is disconnected from tender while being weighed, keep such parts between engine and tender as are supported by the engine—such as draw-bars and safety bars, flexible joints, etc.—on the engine. If locomotive is not disconnected from the tender, have buffer loosened so that there will be no binding of buffer or drawbars. It is preferable not to disconnect the engine and tender unless otherwise necessary.

By "dead weights" is meant the weight of all parts below the spring rigging, and therefore not supported by the spring rigging. The total dead weight must be determined for each pair of wheels separately and for driving wheels is the sum of the individual weights as follows: 1 axle; 2 boxes and saddles or equalizers over boxes, if any; 2 wheel centers; 2 tires; 2 crank pins and all rods bearing on crank pins, both main and side rods. Also eccentric crank for main wheels. One-half of eccentric rod.

For engine trucks, where the weight is carried directly on the engine-truck center plate, the total weight of the truck is dead weight. This is also true for trailer trucks which carry the weight on a single center plate. For other trailing trucks, such as the Delta truck, or articulated trucks, where the weight is carried at more than one point to the truck, the dead weights again become the parts below the truck equalizing system. For such a truck, the dead weights for a pair of wheels include the following: 1 axle; 2 wheels with tires; 2 boxes. If booster is used, add the weight of the booster axle gear and that part of the booster weight which is carried by the axle.

Center of Gravity

The longitudinal center of gravity of a locomotive can be determined by two practical methods. The locomotive can be balanced on a turntable, and when it is perfectly balanced, the center of gravity is directly over the center of the turntable; or by using individual scales, by which the weight on each pair of wheels can be obtained. Some individual scales record the total weight on one pair of wheels, while others record the weight on each wheel. In this latter case, the sum of the two readings must be taken for the total weight on one pair.

When individual scales are used, the longitudinal center of gravity of the total locomotive is obtained as follows:

As a matter of convenience the reference plane from which all moments are taken shall be the vertical center-line of the front wheel of the locomotive regardless of whether there is or is not a front truck.

* A sub-committee report included in the general report of the Committee on Locomotive Construction presented at the June meeting of the Mechanical Division of the Association of American Railroads.

Methods to be followed for calculations from scale weights and turntable balance

The following example will show how this is done:

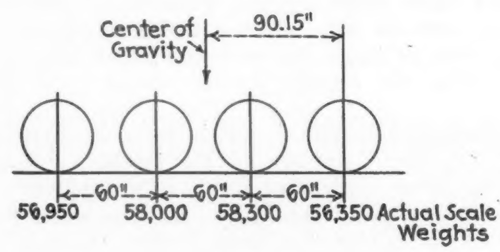


Fig. 1

$$
\begin{array}{rcl}
56{,}350 \times 0 &=& 0 \\
58{,}300 \times 60 &=& 3{,}498{,}000 \\
58{,}000 \times 120 &=& 6{,}960{,}000 \\
56{,}950 \times 180 &=& 10{,}251{,}000 \\
\hline
229{,}600 & & 20{,}709{,}000
\end{array}
$$

$$\frac{20{,}709{,}000}{229{,}600} = 90.15 \text{ in. to center of gravity}$$

After obtaining the center of gravity for the complete locomotive by either of these methods, it is necessary to get the center of gravity for that part of the locomotive carried by the spring rigging which will include everything but the dead weights. To do this, subtract the moment for the center of gravity of all dead weight from the moment for the center of gravity for the complete locomotive, the result being the moment for the spring-borne weight. Dividing this by the spring-borne weight will locate the center of gravity of the spring-borne weight.

After getting the center of gravity of the spring-borne weight, it is necessary to find the proportion of this weight which is carried by each equalizing system, as there are always two separate equalizing systems on a locomotive, one forward and one back. The theoretical point of support of these percentages is the point from which the spring-borne weight is distributed in accordance with the equalizing system.

Distribution of Weights to Axles

To determine the proportion of spring-borne weight on each axle, first consider that the driving axle in each system which has the least dead weight, is unity or 100 per cent. The other axle percentages in each system are determined from this, depending upon the proportion of the equalizers. From the examples illustrated, it can be seen that the front and back driving axles are considered 100 per cent and the spring borne weight for the other axles is proportioned from this, using a lower percentage on axle with higher dead weight so as to keep the rail loads as nearly equal as possible.

After locating the theoretical point of support for each equalizer system, proportion the amount of the total spring-borne weight which comes on each point of support, in accordance with its longitudinal distance from the center of gravity of the total spring-borne weight.

Then for each system, subdivided the weight at the point of support among the various axles, and center plate for the engine truck, according to the percentages previously figured. This will give the distribution of the spring-borne weight to each axle and to this the dead weights are added, giving the distribution at the rail.

The methods of determining the proportion of spring-borne weight on the various axles for the usual arrangements of equalization and accompanying diagrams indicate the method of calculation for getting the center of gravity and for obtaining the weight distribution as outlined for the usual locomotive wheel arrangements.

Determining Percentages of Equalizing Systems

Case 1.—Drivers equalized together (Fig. 2)

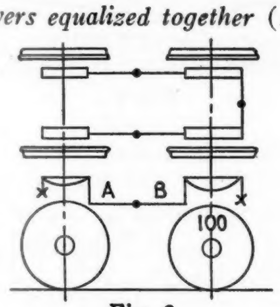


Fig. 2

If we assume 100 per cent for the weight carried on one axle as shown in Fig 2, then the weight carried on the adjacent axle is in proportion to the equalizer arms A and B, and the weight per cent for the adjacent axle is

$$100 \times \frac{B}{A} = \text{per cent on adjacent axle}$$

If more than two axles are equalized, the method becomes continuous, the proportion on any axle being figured from the percentage previously figured for the adjacent axle.

Case 2.—Drivers equalized to engine truck (Fig. 3)

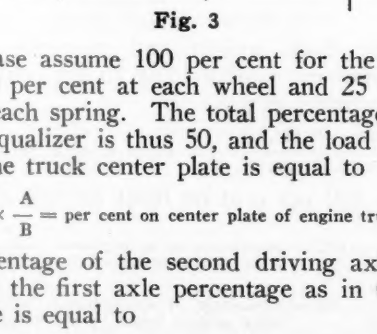


Fig. 3

In this case assume 100 per cent for the front axle, which is 50 per cent at each wheel and 25 per cent at the end of each spring. The total percentage carried to the center equalizer is thus 50, and the load transmitted to the engine truck center plate is equal to

$$50 \times \frac{A}{B} = \text{per cent on center plate of engine truck}$$

The percentage of the second driving axle is determined from the first axle percentage as in Case 1 and for this case is equal to

$$100 \times \frac{C}{D} = \text{per cent on second driving axle}$$

Case 3.—Drivers equalized to two-wheel trailing truck (Fig. 4)

In this case assuming 100 per cent for the back axle, the load on the trailer is calculated just as if it were another driver as two trailer equalizers are used, one to

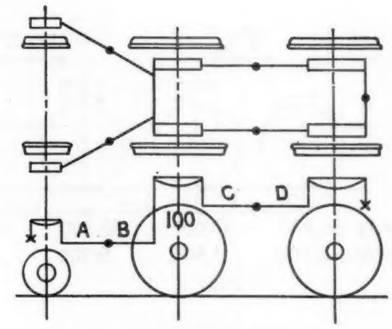


Fig. 4

each spring and wheel. Thus, the per cent of the trailer weight becomes

$$100 \times \frac{B}{A} = \text{per cent on trailer}$$

Also, as in Case 1, the second driving axle per cent is determined from the first axle as follows:

$$100 \times \frac{C}{D} = \text{per cent on second driving axle}$$

Case 4—Drivers equalized to four-wheel trailing truck (Fig. 5)

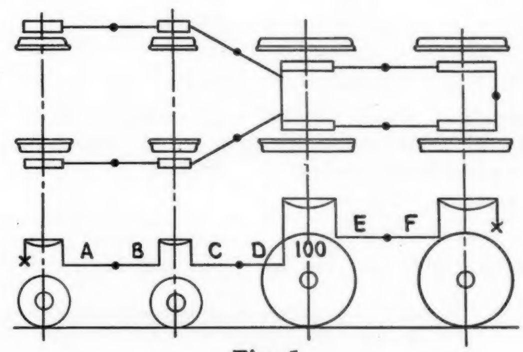


Fig. 5

This is figured just like the two-wheel truck for the front trailer axle, and the back trailer axle is proportioned from the front axles as follows:

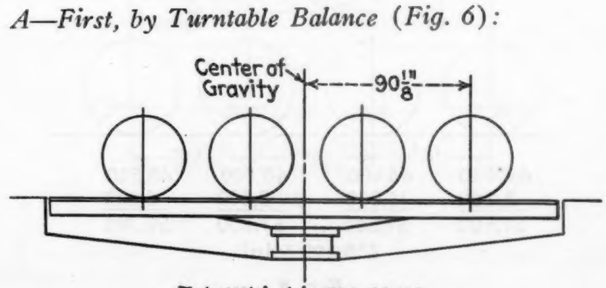
$$100 \times \frac{D}{C} = \text{per cent on front trailer axle}$$

$$100 \times \frac{D}{C} \times \frac{B}{A} = \text{per cent on back trailer axle}$$

$$100 \times \frac{E}{F} = \text{per cent on second driving axle}$$

Determining the Center of Gravity of an 0-8-0 Type Locomotive

A—First, by Turntable Balance (Fig. 6):



Total Weight = 229,600 Lb.
Total Moment = 229,600 x $90\frac{1}{8}$ = 20,709,000

Fig. 6

B—Second, by Calculation from Actual Scale Weights (Fig. 7):

Moments about center line of front wheel for center of gravity of total engine:

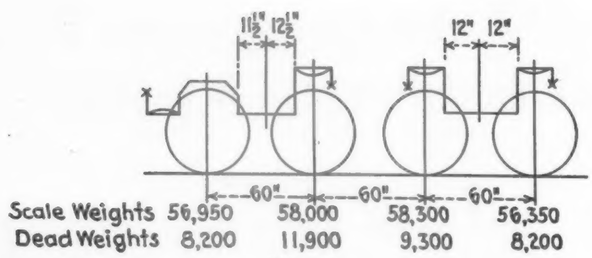


Fig. 7

Scale weights, lb.		Moments
56,350 × 0	=	0
58,300 × 60	=	3,498,000
58,000 × 120	=	6,960,000
56,950 × 180	=	10,251,000
229,600		20,709,000

$$\frac{20{,}709{,}000}{229{,}600} = 90\tfrac{1}{8} \text{ in. to c. of g. total engine}$$

C—Determining Center of Gravity of Spring-Borne Weight.

Moments about center line of front wheel for dead weights:

Dead weights, lb.		Moments
8,200 × 0	=	0
9,300 × 60	=	558,000
11,900 × 120	=	1,428,000
8,200 × 180	=	1,476,000
37,600		3,462,000

Subtracting dead weight and moment from scale weight and moment and dividing to get center of gravity of spring-borne weight:

$$\frac{20{,}709{,}000 - 3{,}462{,}000}{229{,}600 - 37{,}600} = 90 \text{ in. to c. of g. spring-borne weight}$$

Assuming 100 per cent for front and back axles,

$$100 \times \frac{12}{12} = 100 = \text{percentage of spring-borne load on front equalizing system borne by the second set of drivers}$$

$$100 \times \frac{11\tfrac{1}{2}}{12\tfrac{1}{2}} = 92 = \text{percentage of spring-borne load on back equalizing system borne by the third set of drivers}$$

Moments about center line of front wheel for center of gravity of front equalizing system:

100 × 0	=	0
100 × 60	=	6,000
200		6,000

$$\frac{6{,}000}{200} = 30 \text{ in. to c. of g. front equalizing system}$$

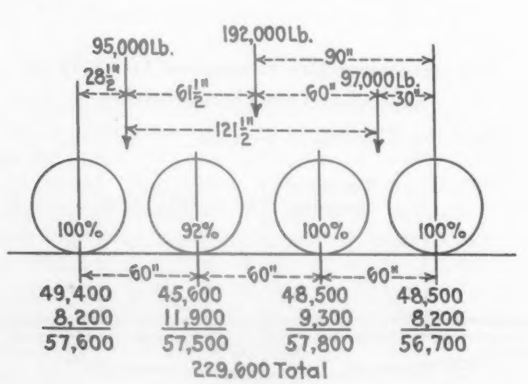


Fig. 8

Moments about center line of back driver for center of gravity of back equalizing system:

100 × 0	=	0
92 × 60	=	5,520
192		5,520

$$\frac{5{,}520}{192} = 28\tfrac{1}{2} \text{ in. to c. of g. back equalizing system}$$

Proportioning the spring-borne weight per axle from actual center of gravity (Fig. 8):

Determining the Center of Gravity of a 4-6-2 Type Locomotive

A—First, by Turntable Balance (Fig. 9):

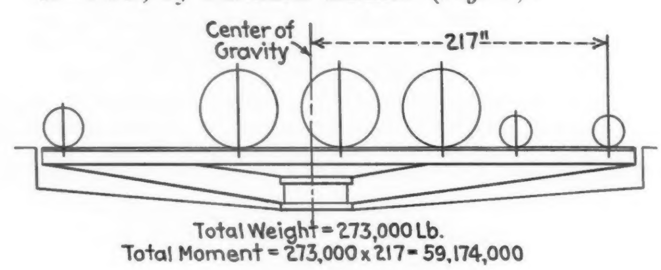


Fig. 9

B—Second, by Calculation from Actual Scale Weights (Fig. 10):

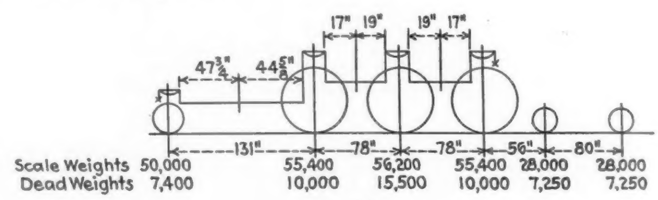


Fig. 10

Moments about center line of front engine-truck wheel for center of gravity of total engine:

Scale weights, lb.		Moments
28,000 × 0	=	0
28,000 × 80	=	2,240,000
55,400 × 136	=	7,534,000
56,200 × 214	=	12,050,000
55,400 × 292	=	16,200,000
50,000 × 423	=	21,150,000
273,000		59,174,000

$$\frac{59{,}174{,}000}{273{,}000} = 217 \text{ in. to c. of g. total engine}$$

C—Center of Gravity of Spring-Borne Weight.

Moments about center line of front engine-truck wheel for center of gravity of dead weights:

Dead weights, lb.		Moments
7,250 × 0	=	0
7,250 × 80	=	580,000
10,000 × 136	=	1,360,000
15,500 × 214	=	3,315,000
10,000 × 292	=	2,920,000
7,400 × 423	=	3,130,000
57,400		11,305,000

Subtracting dead weight and moment from scale weight and moment and dividing to get center of gravity of spring-borne weight:

$$\frac{59{,}147{,}000 - 11{,}305{,}000}{273{,}000 - 57{,}400} = 222 \text{ in. to c. of g. spring-borne weight}$$

Assuming 100 per cent on front driving axle,

$$100 \times \frac{17}{19} = 89.5 = \text{percentage of spring-borne load on back equalizing system borne by the second set of drivers}$$

$$89.5 \times \frac{19}{17} = 100 = \text{percentage of spring-borne load on back equalizing system borne by the third set of drivers}$$

$$100 \times \frac{44\tfrac{5}{8}}{47\tfrac{3}{4}} = 93.5 = \text{percentage of spring-borne load on back equalizing system borne by the trailing wheels}$$

Moments about center line of trailing-truck wheels for center of gravity of back equalizing system:

93.5 × 0	=	0
100 × 131	=	13,100
89.5 × 209	=	18,700
100 × 287	=	28,700
383.0		60,500

$$\frac{60{,}500}{383.0} = 158 \text{ in. to c. of g. back equalizing system}$$

Proportioning the spring-borne weight per axle from actual center of gravity (Fig. 11):

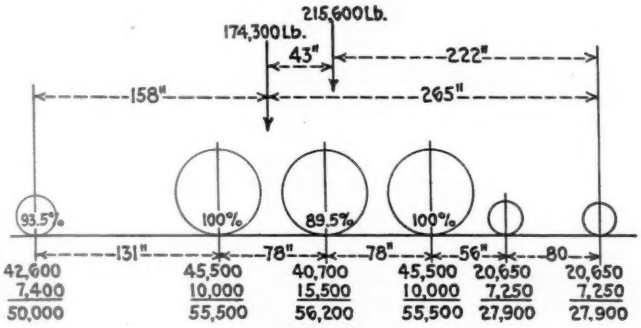


Fig. 11

Determining the Center of Gravity of a 4-6-4 Type Locomotive

A—First, by Turntable Balance (Fig. 12):

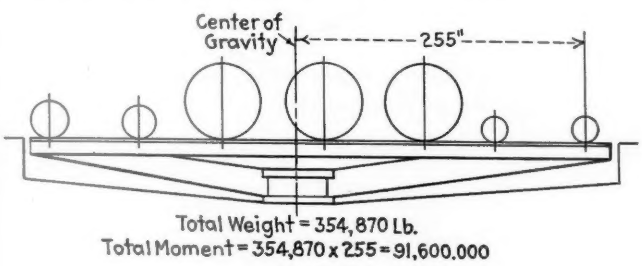


Fig. 12

B—Second, by Calculations from Actual Scale Weights (Fig. 13):

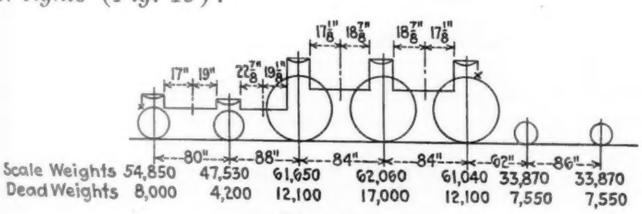


Fig. 13

Moments about center line of front engine-truck wheel for center of gravity of total engine:

Scale weights, lb.		Moments
33,870	× 0 =	0
33,870	× 86 =	2,920,000
61,040	× 148 =	9,030,000
62,060	× 232 =	14,400,000
61,650	× 316 =	19,500,000
47,530	× 404 =	19,200,000
54,850	× 484 =	26,550,000
354,870		91,600,000

$$\frac{91{,}600{,}000}{354{,}870} = 255 \text{ in. to c. of g. total engine}$$

C—Determining Center of Gravity of Spring-Borne Weight

Moments about center line of front engine-truck wheel for center of gravity of dead weights:

Dead weights, lb.		Moments
7,550	× 0 =	0
7,550	× 86 =	650,000
12,100	× 148 =	1,790,000
17,000	× 232 =	3,940,000
12,100	× 316 =	3,820,000
4,200	× 404 =	1,695,000
8,000	× 484 =	3,870,000
68,500		15,765,000

Subtracting dead weight and moment from scale weights and moment, and dividing to get center of gravity of spring-borne weight:

$$\frac{91{,}600{,}000 - 15{,}765{,}000}{354{,}870 - 68{,}500} = 264 \text{ in. to c. of g. spring-borne weight}$$

Assuming 100 per cent for front and back driving axles,

$100 \times \frac{17\frac{1}{8}}{18\frac{7}{8}} = 90.8 =$ percentage of spring-borne load on back equalizing system borne by the second set of drivers

$90.8 \times \frac{18\frac{7}{8}}{17\frac{1}{8}} = 100 =$ percentage of spring-borne load on back equalizing system borne by the third set of drivers

$100 \times \frac{19\frac{1}{8}}{22\frac{7}{8}} = 83.6 =$ percentage of spring-borne load on back equalizing system borne by the front trailer wheels

$83.6 \times \frac{19}{17} = 93.5 =$ percentage of spring-borne load on back equalizing system borne by the back trailer wheels

Moments about center line of back trailing-truck wheels for center of gravity of back equalizing system:

93.5	× 0 =	0
83.6	× 80 =	6,690
100	× 168 =	16,800
90.8	× 252 =	22,900
100	× 336 =	33,600
467.9		79,990

$$\frac{79{,}990}{467.9} = 171 \text{ in. to c. of g. back equalizing system}$$

Proportioning the spring-borne weight per axle from actual center of gravity (Fig. 14):

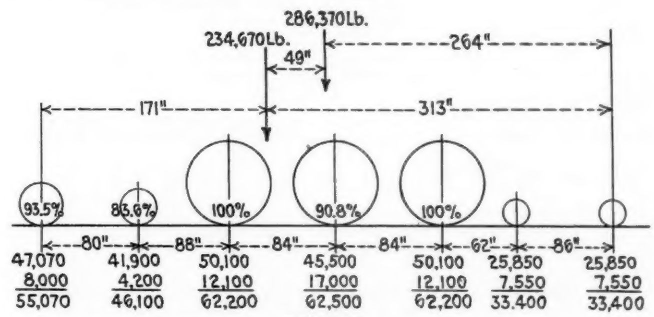


Fig. 14

Determining Center of Gravity of a 2-8-2 Type Locomotive

A—First, by Turntable Balance (Fig. 15):

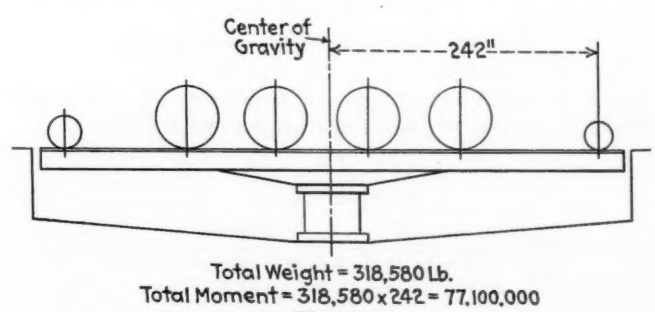


Fig. 15

B—Second, by Calculation from Actual Scale Weights (Fig. 16):

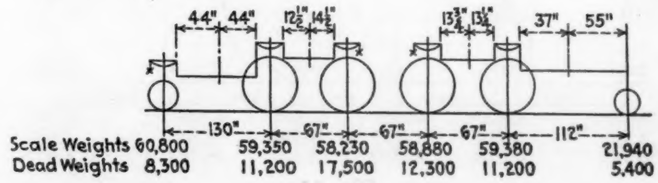


Fig. 16

Moments about center line of engine-truck wheel for center of gravity of total engine:

Scale weights, lb.		Moments
21,940 ×	0 =	0
59,380 ×	112 =	6,640,000
58,880 ×	179 =	10,540,000
58,230 ×	246 =	14,320,000
59,350 ×	313 =	18,600,000
60,800 ×	443 =	27,000,000
318,580		77,100,000

$$\frac{77{,}100{,}000}{318{,}580} = 242 \text{ in. to c. of g. total engine}$$

C—Determining Center of Gravity of Spring-Borne Weight

Moments about center line of engine-truck wheel for center of gravity of dead weights:

Dead weights, lb.		Moments
5,400 ×	0 =	0
11,200 ×	112 =	1,255,000
12,300 ×	179 =	2,200,000
17,500 ×	246 =	4,300,000
11,200 ×	313 =	3,506,000
8,300 ×	443 =	3,680,000
65,900		14,941,000

Subtracting dead weight and moment from scale weight and moment and dividing to get center of gravity of spring-borne weight:

$$\frac{77{,}100{,}000 - 14{,}941{,}000}{318{,}580 - 65{,}900} = 246 \text{ in. to c. of g. spring-borne weight}$$

Assuming 100 per cent for front driving axle,

$$50 \times \frac{37}{55} = 33.6 = \text{percentage of spring-borne load on front equalizing system borne by engine truck}$$

$$100 \times \frac{13\frac{1}{4}}{13\frac{3}{4}} = 96.4 = \text{percentage of spring-borne load on front equalizing system borne by the second set of drivers}$$

Assuming 100 per cent for back driving axle,

$$100 \times \frac{44}{44} = 100 = \text{percentage of spring-borne load on back equalizing system borne by trailing truck}$$

$$100 \times \frac{12\frac{1}{2}}{14\frac{1}{2}} = 86 = \text{percentage of spring-borne load on back equalizing system borne by the third set of drivers}$$

Moments about center line of engine-truck wheel for center of gravity of front equalizing system:

33.6 ×	0 =	0
100 ×	112 =	11,200
96.4 ×	179 =	17,270
230.0		28,470

$$\frac{28{,}470}{230} = 123\tfrac{1}{2} \text{ in. to c. of g. front equalizing system}$$

Moments about center line of trailing-truck wheel for center of gravity of back equalizing system (Fig. 17):

100 ×	0 =	0
100 ×	130 =	13,000
86 ×	197 =	16,950
286		29,950

$$\frac{29{,}950}{286} = 104\tfrac{1}{2} \text{ in. to c. of g. back equalizing system}$$

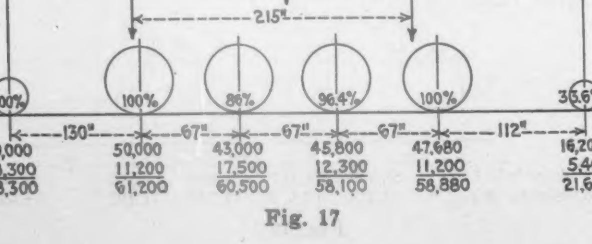


Fig. 17

Determining the Center of Gravity of a 2-10-2 Type Locomotive

A—First, by Turntable Balance (Fig. 18):

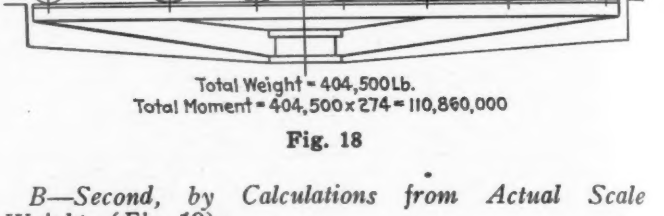


Fig. 18

B—Second, by Calculations from Actual Scale Weights (Fig. 19):

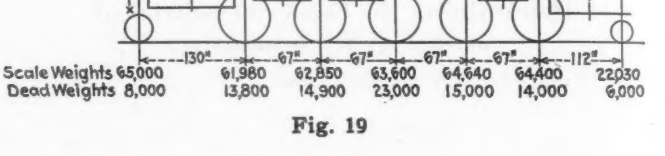


Fig. 19

Moments about center line of engine-truck wheel for center of gravity of total engine:

Scale weights, lb.		Moments
22,030 ×	0 =	0
64,400 ×	112 =	7,210,000
64,640 ×	179 =	11,580,000
63,600 ×	246 =	15,670,000
62,850 ×	313 =	19,700,000
61,980 ×	380 =	23,550,000
65,000 ×	510 =	33,150,000
404,500		110,860,000

$$\frac{110{,}860{,}000}{404{,}500} = 274 \text{ in. to c. of g. total engine}$$

C—Determining Center of Gravity of Spring-Borne Weight

Moments about center line of engine-truck wheel for center of gravity of dead weights:

Dead weights, lb.		Moments
6,000 ×	0 =	0
14,000 ×	112 =	1,568,000
15,000 ×	179 =	2,685,000
23,000 ×	246 =	5,650,000
14,900 ×	313 =	4,660,000
13,800 ×	380 =	5,240,000
8,000 ×	510 =	4,080,000
94,700		23,883,000

Subtracting dead weights and moment from scale weight and moment to get center of gravity of spring-borne weight:

$$\frac{110{,}860{,}000 - 23{,}883{,}000}{404{,}500 - 94{,}700} = 281 \text{ in. to c. of g. spring-borne weight}$$

Assuming 100 per cent for front driving axle,

$$50 \times \frac{33\frac{3}{4}}{58\frac{1}{4}} = 29 = \text{percentage of spring-borne load on front equalizing system borne by engine truck}$$

$$100 \times \frac{13\frac{3}{8}}{13\frac{5}{8}} = 98 = \text{percentage of spring-borne load on front equalizing system borne by the second set of drivers}$$

Assuming 100 per cent for back driving axle,

$$100 \times \frac{46}{42} = 110 = \text{percentage of spring-borne load on back equalizing system borne by the trailing truck}$$

$$100 \times \frac{13\frac{3}{8}}{13\frac{5}{8}} = 98 = \text{percentage of spring-borne load on back equalizing system borne by the fourth set of drivers}$$

$$98 \times \frac{12\frac{1}{4}}{14\frac{3}{4}} = 81.7 = \text{percentage of spring-borne load on back equalizing system borne by the third set of drivers}$$

Moments about center line of engine-truck wheel for center of gravity of front equalizing system:

29	×	0	=	0
100	×	112	=	11,200
98	×	179	=	17,550
227				28,750

$$\frac{28{,}750}{227} = 126\tfrac{1}{2} \text{ in. to c. of g. front equalizing system}$$

Moments about center line of trailing-truck wheel for center of gravity of back equalizing system:

110	×	0	=	0
100	×	130	=	13,000
98	×	197	=	19,300
81.7	×	264	=	21,600
389.7				53,900

$$\frac{53{,}900}{389.7} = 138 \text{ in. to c. of g. back equalizing system}$$

Proportioning the spring-borne weight per axle from actual center of gravity (Fig. 20):

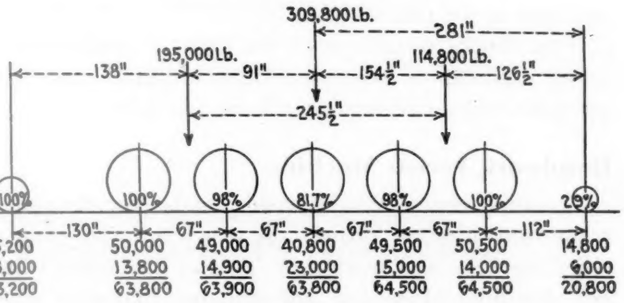


Fig. 20

Determining the Center of Gravity of a 2-10-4 Type Locomotive

A—First, by Turntable Balance (Fig. 21):

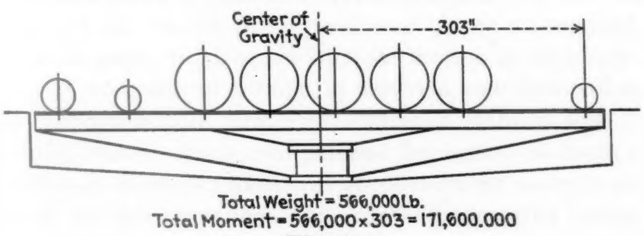


Fig. 21

B—Second, by calculation from actual scale weights (Fig. 22):

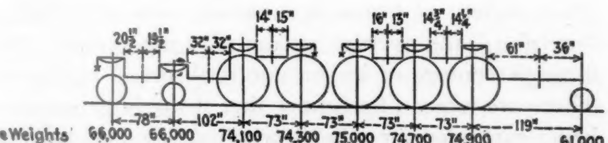


Fig. 22

Moments about center line of engine-truck wheel for center of gravity of total engine:

Scale weights, lb.				Moments
61,000	×	0	=	0
74,900	×	119	=	8,900,000
74,700	×	192	=	14,350,000
75,000	×	265	=	19,900,000
74,300	×	338	=	25,100,000
74,100	×	411	=	30,450,000
66,000	×	513	=	33,900,000
66,000	×	591	=	39,000,000
566,000				171,600,000

$$\frac{171{,}600{,}000}{566{,}000} = 303 \text{ in. to c. of g. total engine}$$

C—Center of Gravity of Spring-Borne Load

Moments about center line of engine-truck wheel for center of gravity of dead weights:

Dead weights, lb.				Moments
8,300	×	0	=	0
12,500	×	119	=	1,490,000
14,400	×	192	=	2,768,000
25,900	×	265	=	6,870,000
17,800	×	338	=	6,020,000
13,100	×	411	=	5,380,000
5,000	×	513	=	2,565,000
8,000	×	591	=	4,728,000
105,000				29,821,000

Subtracting dead weights and moment from scale weight and moment to get center of gravity of spring-borne weight:

$$\frac{171{,}600{,}000 - 29{,}821{,}000}{566{,}000 - 105{,}000} = 307\tfrac{1}{2} \text{ in. to c. of g. spring-borne weight}$$

Assuming 100 per cent on front driving axle,

$$50 \times \frac{61}{36} = 84.6 = \text{percentage of spring-borne load on front equalizing system borne by the engine truck}$$

$$100 \times \frac{14\tfrac{1}{4}}{14\tfrac{3}{4}} = 96.5 = \text{percentage of spring-borne load on front equalizing system borne by the second set of drivers}$$

$$96.5 \times \frac{13}{16} = 78.5 = \text{percentage of spring-borne load on front equalizing system borne by the third set of drivers}$$

Assuming 100 per cent on back driving axle,

$$100 \times \frac{14}{15} = 93 = \text{percentage of spring-borne load on back equalizing system borne by the fourth set of drivers}$$

$$100 \times \frac{32}{32} = 100 = \text{percentage of spring-borne load on back equalizing system borne by the front trailing wheels}$$

$$100 \times \frac{19\tfrac{1}{2}}{20\tfrac{1}{2}} = 95 = \text{percentage of spring-borne load on back equalizing system borne by the back trailing wheels}$$

Moments about center line of engine-truck wheel for center of gravity of front equalizing system:

84.6	×	0	=	0
100	×	119	=	11,900
96.5	×	192	=	18,530
78.5	×	265	=	20,800
359.6				51,230

$$\frac{51{,}230}{359.6} = 142\tfrac{1}{2} \text{ in. to c. of g. front equalizing system}$$

Moments about center line of back trailing-truck wheels for center of gravity of back equalizing system:

95	×	0	=	0
100	×	78	=	7,800
100	×	180	=	18,000
93	×	253	=	23,500
388				49,300

$$\frac{49{,}300}{388} = 127 \text{ in. to c. of g. back equalizing system}$$

Proportioning the spring-borne weight per axle from actual center of gravity (Fig. 23):

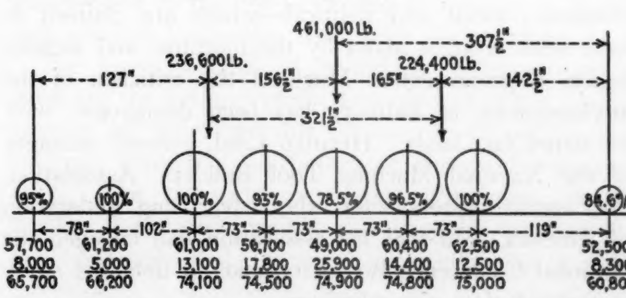


Fig. 23

Report signed by R. S. McConnell, Baldwin Locomotive Works; J. G. Blunt, American Locomotive Company, and W. E. Woodard, Lima Locomotive Works, Inc.

EDITORIALS

Man-Power

A hard-headed, successful mechanical department official has added a number of college graduates to his force, in the belief that they will be sorely needed when business picks up and the mechanical department is pressed to meet the demands which will be made upon it for serviceable equipment.

Another railroad—at one of its important shop points, at least—has maintained for the past year or so a goodly number of regular apprentices and a few special apprentices, in the belief that well-trained mechanics and technical men will be needed badly when conditions return more nearly to the normal.

Those who have studied the industrial situation at large insist that with the slowing down, or in some cases, practical elimination, of recruiting and training in recent years serious hazards will be involved when industry attempts to speed up, because of the lack of skilled workers. No one seriously questions such statements, and yet under present conditions, and those which have existed during recent years, it is difficult to get action. The far-sighted executives, however, are beginning to sense the situation and take steps to protect their properties.

A railroad or industry interested in recruiting from the ranks of high school and college graduates will find excellent material available. Will it not pay good dividends later on to put some of these young men in training now so that they will be in position to function most effectively when they are needed a few months or a year hence?

Technological Unemployment

There has been much discussion about the evils—economic, social and political—which are claimed to have been brought about by the machine, and technological improvements. Much of the criticism of the mechanization of industry has been demagogic, with no sound fact basis. Herman Lind, general manager of the National Machine Tool Builders' Association, in a recent address before the Advertising Federation of America, said that his association had engaged the National Conference Board to make an unbiased study of technological unemployment.

"While this study is still in process," said Mr. Lind, "the reports up to this time indicate that since 1870 the working population has increased at a rate one-third greater than the increase in the total population. During the 60 years from 1870 to 1930, the total population increased from 38.5 millions to 122.7 millions, or nearly three times. At the end of this period, which was marked by rapid technological improvements in industry, vast introduction of labor-saving devices, and enormous mechanization of industry, a larger proportion of the total population was employed in the production of goods and services than at the beginning. The total number of persons engaged in gainful occupations at the end of 1930 was 42,829,920, or 39.8 per cent of the population, as against 12,505,923, or 32.4 per cent at the end of 1870."

This checks roughly with the general conclusions of many students of economics and industry who have attempted to do research work in this field.

Handwork Versus Machine

A county engineer in an eastern state recently visited a highway grading project on which a large gang of relief workers was working. Two of the relief workers, dawdling along and not realizing that they could be overheard, conversed thus:

"Do you know who that big guy over there is?"

"No, who is he?"

"That's the county engineer in charge of this project."

"Hell, I don't think much of him. If he knew his business he would have a steam shovel on the job and would do in a week what it will take our gang of over a hundred men a couple of months to complete."

The road is a main artery with heavy travel. It cannot be completed because the county cannot afford to increase taxation to do the more expensive finishing work, although the entire job could probably be done properly for the amount of money which will be expended for grading from the federal and state relief funds now being used so wastefully.

The taxpayer is paying the bill, although with our great variety of forms of taxation, some of which are "invisible," the average citizen may not realize what a large percentage of his income is absorbed in this way. There are many who believe that if the huge sums now being expended for relief work could be used more efficiently and effectively it would quickly stimulate the capital or heavy goods industries, calling unemployed in these industries back to work, and in turn reacting favorably upon the consumers' goods and service industries.

Wear, Tear and Obsolescence

The speeding up of industry, with the renewal of confidence which would accompany it, would quickly focus attention on the wear, tear and obsolescence which has piled up in the last five years. The deficiencies brought about by these factors and just plain

old age, says Mr. Lind, "are stupendous and it is not difficult to find estimates of modernization and rehabilitation requirements running to well over a hundred billion dollars. This great unsatisfied need constitutes a tremendous vacuum that awaits the means to be filled, and it is well recognized that it should be filled. To do this requires the expenditure of an amount of money that would make our public works programs, large as they are, appear pigmy sized."

Money and credit are available if the powers at Washington will concentrate on recovery. A natural tendency to recovery has been under way for a long time, but it cannot overcome the effect of half-baked unwise legislation which is constantly being threatened or enacted, and which breaks down the morale and prevents the restoration of confidence—the most vital factor in any real recovery.

British Schedules and Locomotive Performance

Even more interest is being shown in expediting passenger-train schedules in England than in the United States and here a rapid development of popular interest has followed the spectacular long-distance performances of the light-weight articulated trains of the Union Pacific and the Chicago, Burlington & Quincy of last year. One of the most recent of the outstanding performances in England was on the London, Midland & Scottish where a train of 15 vehicles, including a dynamometer car, weighing 508 tons, on a trip from Liverpool to London on June 27, made a start-to-stop run of 152.7 miles from Crewe to Willesden Junction in 129 min. 33 sec. This average speed of a fraction over 70 miles an hour required a maximum speed of 86.6 miles an hour. A few days later a further dynamometer run was made between Crewe and Glasgow and return, a distance of 486.6 miles, with 20 vehicles, including the dynamometer car, weighing 516 tons. On this run no exceptionally high speeds were attempted. Its purpose was to determine the capacity of the locomotive for sustained power with heavy loads over a line on which a number of severe grades are encountered.

These runs, which are roughly comparable in point of revenue service capacity with some of our heaviest American passenger trains, were made with a Princess Royal Class Pacific type locomotive with a weight on drivers of 151,200 lb. and a combined weight of engine and tender amounting to 177.6 tons. Their performance on the Crewe to Glasgow and return run, on which they averaged 2.88 lb. of coal per drawbar horsepower hour with an evaporation of 7.45 lb. of water per pound of coal, is ample evidence of a finely proportioned locomotive. The coal fired averaged 52.6 lb. per mile. These locomotives, among the heavy passenger power of Great Britain, have a nominal cylinder horsepower capacity upwards of 2,000.

To many Americans the performance of schedules with the heaviest passenger trains which here customarily call for trains of extremely limited consist, with a fuel consumption so light that a 10-ton tank of coal is good for a run of nearly 400 miles, seems almost inexplicable. Does it mean that in some mysterious way British locomotives are superior to those which we build in America? An examination of the facts removes the apparent mystery from the comparison.

In the London, Midland & Scottish runs cited the combined weight of locomotive and train amounts to slightly less than 700 tons, so that a cylinder horsepower capacity of something more than three horsepower per ton of total weight hauled is available. Our heavy passenger trains, which in point of capacity may be roughly compared with the best trains of the London, Midland & Scottish, will scarcely weigh less than 1,500 tons, including the weight of the locomotive—more than twice the weight of the British trains. To provide the same horsepower-weight ratio, which is needed for the movement of such trains as expeditiously as the British trains are operated, would require close to 5,000 cylinder horsepower. So far, 4,000 cylinder horsepower marks about the maximum capacity of American passenger locomotives.

While the fuel rate of the Princess Royal class of Pacific type locomotives of the London, Midland & Scottish is exceptionally low, a direct comparison with American performance is not feasible without a knowledge of the fuel heating values. In any case, however, the important factor in producing such a strikingly low overall fuel performance, when measured by American standards, is the light weight of the equipment such that a maximum of some 2,000 cylinder horsepower and an average not to exceed 900 or 1,000 drawbar horsepower is normally required to operate the heaviest trains.

While the fuel and schedule performances are striking, a more detailed study might well bring to light even more significant advantages of light-weight equipment in the ability to develop well proportioned locomotives with low axle loads, with all that this implies with respect to the design of smooth running machines and reduced locomotive and track maintenance.

The heavy weights of American passenger rolling stock are the heritage of the first quarter of the present century in which growth in volume of service and revenues created a psychology of bigness for its own sake. The railroads can divest themselves of the burden of excessive weight slowly at the best, but the new materials and attention to refinements in their distribution in equipment design will undoubtedly effect a steady improvement. Passenger locomotive capacities exceeding those already in service, if ever built at all, will undoubtedly be in small numbers and capacities may rather be expected to recede.

When We Get the Money For Shop Equipment * * *

Frequently in these days mechanical officers and supervisors express the opinion that railroad shops are greatly in need of machine tools and shop equipment to replace many of the obsolete units now in service and that the railroads will have to do some rather extensive buying, "when we get the money". Where does the money come from to provide for improvements to facilities used for the maintenance of equipment? In years past the funds came from the expansion of industry and the consequent increases of railroad traffic—in fact, up to the period of the World War rail traffic doubled itself approximately once each twelve years and rail managements planned improvements in facilities with the confidence that future increases in business would provide the funds with which to pay for the improvements. Today that situation has changed. Competition has entered the picture and this, with other causes, has been responsible for the falling off of railroad business to a point where many roads find it difficult to meet fixed charges, let alone provide funds for improvements.

There is now no questioning the fact that railroad managements in the future will have to make their profits from economies in operation and, fortunately, extensive economies in operating and maintenance practices are possible. Studies which have been made by the railroads and outside agencies indicate that many such savings may be made by the installation of modern cost-saving shop equipment. Some of the more progressive railroads invested in a substantial number of modern units of shop equipment just prior to 1929 and, as a result, have had an opportunity to observe at first hand the advantages of this equipment over that installed several years ago. There are numerous instances where modern tools have paid for themselves on locomotive machine-shop operations in as short a period as two and three years and, as a result, the costs of repair work have been reduced considerably.

Modern shop equipment not only makes possible the savings which are the result of greater productive capacity, but also eliminates the expense of repairing equipment of obsolete design. This latter factor is of considerable importance for, on machine tools particularly, the cost of repairs on old units frequently represents an annual expense of from five to seven per cent of the original investment.

If those in charge of the average locomotive shop would select a group of machines of the age of 20 years and older in their own shop and make accurate studies of the comparison of productive capacity and repair cost of these with modern tools, it is quite likely that they would be surprised to find that savings of from 25 to 75 per cent in the cost of machine operations alone could be effected. In addition, these modern machines will, as a rule, do more work than two or three of the obsolete types and, as a result, there will be savings due to decreased repair costs and lower power consumption.

In view of the money that is actually being paid out by railroad shops under present conditions in the production of work on inefficient shop equipment and the additional expenditures for repairing obsolete equipment and keeping it in service, it is evident that the railroads would not need to wonder when and where they will get the money for needed shop facilities if they would do as many other industries have done and replace the obsolete with modern equipment that will pay for itself.

NEW BOOKS

THE ENGINE INDICATOR. *By K. J. DeJuhasz, assistant professor of engineering research, Pennsylvania State College. Published by Instruments Publishing Company, 330 West Forty-second street, New York, 240 pages, 5½ in. by 8½ in.; about 300 illustrations. Cloth binding. Price, $3.75, including a year's subscription to Instruments.*

A considerable number of books dealing with the subject of engine indicators have been issued in the past as evidenced by the list contained in the bibliography included in the appendix. None of them, however, covers the developments which have been made in recent years to provide the instruments needed by makers and users of modern high-efficiency steam and internal-combustion engines. The indicator has served as the guide in the development of the steam engine and also later in the development of the internal-combustion engine. The first instrument, as conceived by James Watt in 1790, was only an indicator and has no recording means. It is highly probable that by watching its pointer Watt received the inspiration for his great invention, the expansive working of steam. In 1796 John Southern improved the indicator by substituting a recording pencil for the simple pointer. Some time between 1825 and 1830 John McNaught began to build a simple form of recording steam engine indicator. This answered requirements for slow-speed engines until 1862 when Professor C. B. Richards reduced the travel of the indicator piston by introducing a magnifying recording gear. This improvement was made in connection with his work of developing the Porter-Allen engine which was the first successful really high-speed steam engine. In 1879 George H. Crosby made improvements in construction of the magnifying gear and, later, in the spring and in its connection to the piston. Following the historical data the general arrangement and component parts of the indicator are taken up. This includes reducing gears interposed between the crosshead or other reciprocating part and the cord driving the indicator drum. After treating normal type indicators, indicators for special purposes, for high speed engines, for high pressures and for mean pressures are covered. Data are also given for testing and calibrating. An analytical theory of the indicator and an appendix completes a comprehensive treatment of the subject.

THE READER'S PAGE

Much Non-Standard Material Paid for by Car Owner

To the Editor:

If a road makes wrong repairs to equipment, it must attach its defect card covering same and, when the car reaches home, the non-standard material should be removed promptly and bill rendered against the road that issued the defect card. In many cases when the car reaches the home line the car owner fails to correct the wrong repairs, for which it has an allowance of twenty-one months in accordance with Rule 5, and allows the car to run. In a short time the defect card becomes lost or out of date and soon these same parts become defective on some other foreign road and as, in many cases, this road has nothing to show that the defects are not standard to the car and makes the necessary repairs and renders bill against the car owner for labor and material. If the non-standard material on the car were removed on first receipt of car on home line, the owner could collect, whereas if the car is allowed to remain in service and card becomes lost or out of date and these non-standard parts are renewed and bills rendered against the car owner, this means that the road is paying foreign lines to make wrong repairs to its equipment.

W. H. Shiver.

A Safety Loophole

To the Editor:

The legislators in a western state are now greatly concerned about passing laws relative to the safe transportation of petroleum products and other dangerous articles. The understanding is that such laws, if passed, must not conflict with the I.C.C. regulations and, therefore, it seems they would have to be duplications and are not entirely necessary. Whether or not they are so considered, it must be kept in mind that they are made for the protection of life and property and they must be complied with.

If all of the people who are in any way concerned with the transportation of dangerous commodities would study and make an honest effort to understand the I.C.C. Regulations, the results would be better. At least there would be fewer deaths and injuries caused by carelessness.

While there is still room for improvement, carmen generally have a fairly good understanding of the hazards involved and it seems apparent, with a few slight changes in the Regulations, the cause of many accidents could be eliminated. If, for instance, such paragraphs as 670, 692 and 693 and others pertaining to the dangers of fire, were changed so that the use of open flame lanterns would not be permitted under any circumstances, the greatest hazard would be removed. State laws could be made to cover such provisions without conflicting with the I.C.C. Regulations.

In paragraph 692 of the I.C.C. Regulations the last sentence reads: "Incandescent electric lights or portable electric flashlights *should* be used *when available*." If a change in this last sentence was made so that the use of electric lanterns or flashlights was mandatory and that such lanterns or lights *must be kept available at all times* for the examination or inspection of cars containing dangerous articles of any kind, it would overcome the main source of trouble, deaths and injuries resulting from leaking tank cars carrying inflammable liquids.

T. B. Aldridge, Jr.

Pokes Fun At Marinac

To the Editor:

In the March issue of the *Railway Mechanical Engineer*, page 100, I noticed an illustration, "Rail Oddities" by Marinac, entitled, "A Railroad Driven by Sails is Used Near Hull, England. Does Four Miles in Eight Minutes." As a matter of fact, I don't wonder that it only does four miles in eight minutes, if the crew as illustrated doesn't know anything more about sailing than is shown in the picture. The locomotive, with mainsail which almost looks like a leg-o-mutton, is O.K. as far as I can see, and there's no reason why they shouldn't be sailing along pretty swiftly, except for the fact that the passenger car tailing up behind looks like a square rigged sort of a gadget, and with its sail set the way it is bellying out with the wind pressure from the advance motion, it looks like a pretty fair retarding medium. Another thing that doesn't hold true in this picture is the fact that regardless of the sail bellying out and retarding the passenger car, the chain has a slack in it, showing that the passenger car is catching up to the locomotive!

As a matter of fact, just humorously, I'd almost like to make a bet that the train is going to the left instead of to the right! However, this whole letter is just a little bit humorous, so I'm not sincere, only I thought that knowing what you do about sailing, you'd be interested in the comments of a land-lubber like myself!

R. C. Bullard.

[Editor's Note—Marinac after reading the above letter, came back with this statement: "It seems very interesting indeed to see what detailed reaction you have from your readers, especially this one, and he is 'sincerely humorous' about it, and should be as it is a cartoon and not an engineered specification drawing or construction blueprint. Apparently he does realize what a caricatured cartoon is, but then life and interpretation is different with every one. I depicted the sail-railroad to be in stationary form. The action of the men alone shows them hoisting and adjusting the sails and the chain proves that the cars are not in motion, with a slight breeze only indicated by the small "aft" sail—so they sit and wait for a good breeze to propel them on the rails. Hoping that this will alleviate your subscriber's humorous satire—J. G. Marinac."]

With the

Car Foremen and Inspectors

Progressive Car Repairs On the Great Northern*

By F. Cebulla

THE progressive system of rebuilding or repairing freight-car equipment, as ordinarily installed, is an arrangement of shop facilities to establish work classifications, separating major classes of work into individual sections or stations over a designated shop track or tracks. The purpose of the progressive system is to avoid duplication of facilities and tools, to reduce the cost of material handling, to obtain maximum speeding up of the various operations and to provide a steady flow of production.

A number of factors must be given consideration and should be worked out in conformity with available shop layout or facilities prior to the actual undertaking of work if good results are desired.

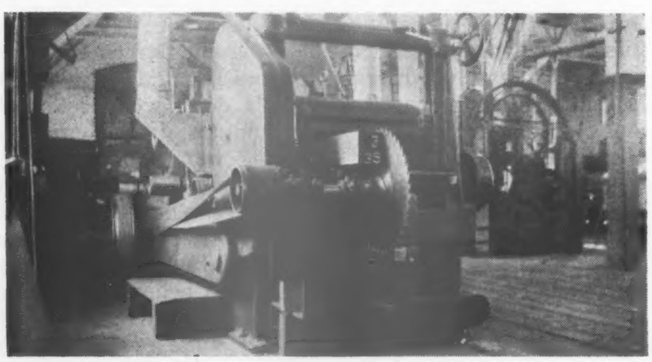


Fig. 1—Large timber planer with rip saw attachment—Center sills and intermediate sills from refrigerator cars were ripped from 4 in. by 9 in. to 4 in. by 4 in.—Crevices for insulation boards were gained and sills ripped in one operation

1—Experience has shown that, under a program of heavy repairs, cars should be selected by series and classified by approximately uniform nature of required repairs. Under a rebuilding program, cars should be selected by series or class. If more than one series of cars is to be rebuilt at one and the same time, each series should be handled under a separate organization.

2—Stripping facilities should be established upon a track best suited for economical disposal of scrap wood, material for reconditioning, scrap metal parts and where stripping will not interfere with actual rebuilding. Oxygen and acetylene gas, water and air-line locations should not be overlooked when selecting the stripping yard. However, this should be governed by the volume of work covered by the program. If any part of cars require sandblasting, a portable sandblasting outfit located at one end of the stripping yard will avoid unnecessary switching.

3—The repair shop should have suitable scaffolding and material storage spaces at stations with passages open at all time for material deliveries. At some shops, standard-gage tracks are thought to be essential. It has been my experience that when shop tracks are spaced on 24-ft. centers or more, equipped with adjustable permanent scaffolds, the use of the standard-gage material track is not essential. Classifying or assigning work to the stations should be made with due respect to available material, transporting equipment, and facilities to handle, with a view of storing bulky or heavy material at stations of easy access if practical.

Proper selection of foremen to supervise work under the progressive system should be considered of utmost importance. Experience will show that foremen of indisputable merit are absolutely essential to the success of the progressive system.

Foremen should be given ample opportunity to study thoroughly the nature of the work contemplated and material requirements before hand. They should be on the ground assisting in working out all details within the scope of the work under the program, thereby gaining useful knowledge all around of the actual status of the organization, and when work is actually under way they will be in a fit condition to direct the operation efficiently.

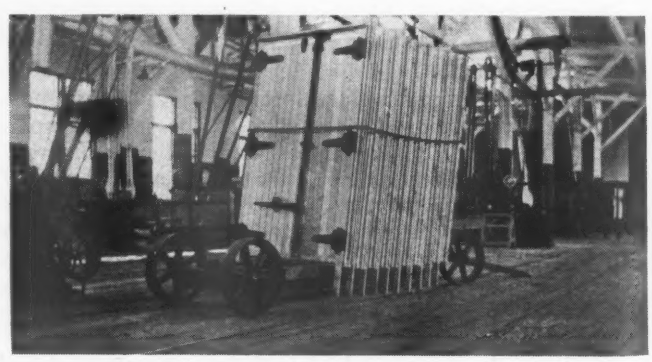


Fig. 2—Trailer loaded with refrigerator car side doors and frames

Many Problems Develop in the First Few Days

Many problems have to be solved during the first few days, because in spite of the fact that the planning received energetic supervision before hand, the going will

* Abstract of a paper presented at the May meeting of the Northwest Car Men's Association, St. Paul, Minn. Mr. Cebulla is shop superintendent of the Great Northern at St. Cloud, Minn.

not be smooth, and close observation will be necessary. The most common problems or difficulties prevalent at the beginning are about as follows:

Imperfect or incomplete material fabrications.
Wrong location of material storage places.
Unsuitable tools.
Inefficient or awkward facilities and appliances.
Irregular volume of work assignment to stations.
Improper selection of men for work which they are not capable of performing properly.

The success of work under the progressive system will be measured by the actual extent of effort exerted by the supervision during the early stages of organizing. Laxity in this respect will result in expensive delays because of the fact that a single station, if not functioning, will retard progress throughout the entire organization. Frequent interference with uniform operations, caused at one or more stations, if not corrected immediately, will destroy the good habits of men in all other stations which will be difficult to restore.

I presume it is the custom at all shops when a heavy program covering rebuilding of cars is considered to rebuild one car first and thus ascertain the proper material requirements. I know that such a practice is very desirable when the work is to be done under the progressive system, because it affords a splendid opportunity for a study of all requirements, tools, material, facilities, appliances, and merits of men best fitted to perform certain classes of work. I, therefore, strongly advocate that as soon as the line-up has been decided on, and all facilities thought necessary have been provided, that one car be put through the shop, running slowly through all the stations, completing in each station the work planned on, noting carefully all moves of men, material and tool handling necessary in connection with the work, and checking dimensions and fabrications of material for corrections, if necessary.

If important changes are decided on in the set-up, the performance should be repeated by running a second car through for a final test of the entire set-up.

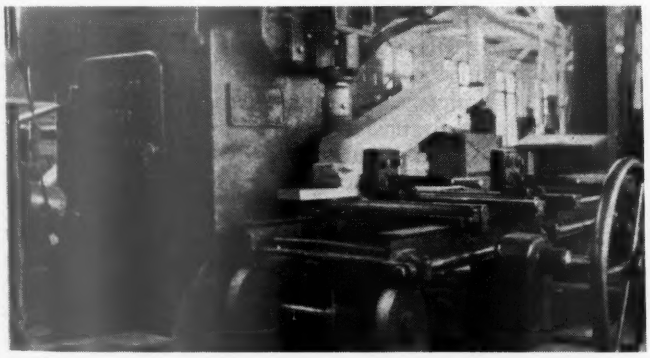


Fig. 3—Tool attachment to mortising machine used in shaping rounded portion of side-door styles

Fabrication of all necessary material should commence far in advance of actual assembling, but not until all items have been checked during the process of rebuilding the sample car so that all stations have a full supply of material and assurance of a steady supply after work is started through the stations. Quantity of reserve material in stock should be governed by the capacity of the fabricating shop, storage space at stations, and by the daily production demand in completed units or cars. It is a fact that a number of shops have large material fabricating shop capacities, and material is delivered from fabricating shop direct to stations at the assembling shop, doing away with the costly rehandling of material to and from reserve stock piles or stores.

When all stations are supplied with a full line of material, the work should be put under way promptly and according to the station line-up of men decided on during the rebuilding process of the sample car, gradually increasing the number of men required at the stations to complete the work allotted to them. As soon as the stations have been filled with cars, the next item of importance is to regulate the spotting of the cars, which means the actual time consumed between the individual

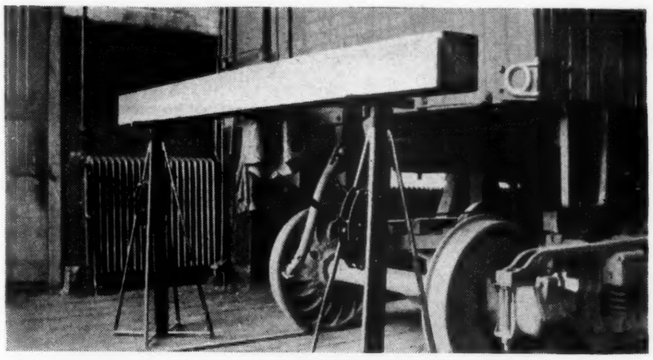


Fig. 4—Light jacks used for hoisting end sills into position

stations to complete their allotment of work. A careful observance of all moves made by men at the station will reveal any lost motion that may exist; or if any stations have been overlooked with work, adjustments should be made accordingly with a view of finishing work in all stations approximately simultaneously.

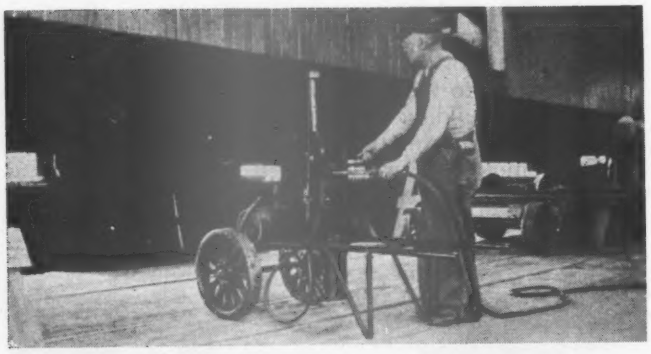
A blackboard located conspicuously, indicating thereon the time of car spotting, will be of much help in getting the spotting regulated quickly, and after a few days the spotting time may be bulletined on this blackboard each morning covering the entire day. In a few days the men will become accustomed to their tools, material, and nature of work, and will complete their work in much less time. The time for spotting should be regulated accordingly. Care should be taken to observe if the improved performance is general in all stations so as not to shorten the time at the expense of a few hard-working individuals. If difficulties arise at any stations through no fault of any individual, supervisors should arrange for prompt, temporary assistance, avoiding thereby delays throughout the entire line-up.

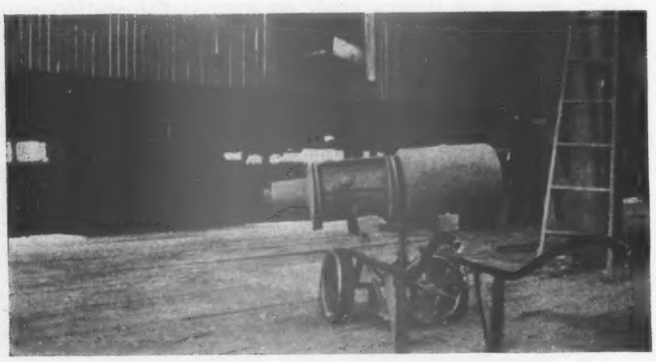
Progressive System Desirable from Employees' Standpoint

There is no doubt but that the progressive system is more economical, practical, and desirable from the employees' standpoint than the old system of repairing cars on the spot, provided shop layout and facilities are adaptable.

Economies can be effected in switching cars into and out of the shop; in every step of material handling, fabrication, delivery, storing and storekeeping, beginning from the raw material yard to the fabricating plant, through various machines and finally to the stations; in machine and tool requirements; upkeep of tools; and in actual labor in connection with the construction.

Switching required to set cars in at one end of the track without spacing can be done to suit the operation of the switcher on other work either night or day. Material fabrication is governed by station order requirements, reducing the fabrication of many varieties of material to a comparatively few each day, thereby affording fabrication of larger quantities of each kind of material





and reducing the cost of tool- or die-changing and back movement of material on the shop floor.

Handling of material is simplified at stations where bulky or awkward material is used by the erection of jib or other cranes; while this would not be possible under the old system of repairing cars on the spot unless the entire shop track were covered by a traveling crane or jib cranes erected at each station.

A saving in motors, tools and maintenance is effected because it is possible to increase the motor work hours per day, and men become more skilled in handling them when using one class of tools continuously.

The spotting of cars to stations by means of an endless cable driven by an electric or air motor governed by air signals, and under the supervision of one man well trained in his duties and safety, reduces the cost of handling to the lowest possible figure.

Three-Group Operation on Steel-Underframe Car

The progressive station-to-station system is adaptable to good advantage in rebuilding any class of equipment and is comparatively simple. A large daily output can be turned out over a single track of average length. However, if wooden equipment is to be steel underframed, new trucks applied and bodies rebuilt at the same time, it is necessary to segregate the entire operation into at least three different groups: the first group to consist of the stripping; the second, truck work, steel underframing and work to bodies incidental to underframing, and the third to rebuilding of the bodies. This grouping is necessary because the rebuilding of bodies can be handled under the straight station-to-station system, while the underframing requires a somewhat different arrangement due to the fact that trucks are out from under the bodies during the truck rebuilding process and because the body work incidental to underframing must be under way while trucks are rebuilt and frames loaded on trucks in order to avoid delays or the necessity of concentrating a large number of men on this class of work. For that reason, the cars cannot be moved from station to station while this work is going on.

The following outline is based on rebuilding and steel underframing of equipment requiring the largest variety of material and labor, which, in my estimation, is the refrigerator car; that the daily output is approximately 10 cars. The layout for grouping is as follows:

Group No. 1—Stripping Cars.—Two tracks are essential for this purpose, one of approximately 20 car lengths, arranged so that burning and cutting is done first at one end of the track and the cars pulled through several stations during the process of stripping to facilitate loading of scrap wood, rubbish and other material into self-clearing trailers direct off the cars. This avoids congestion and fire hazards from cutting torches.

Fig. 5—(Top) Portable tie rod rethreading machine as used under a car; Fig. 6—A saw cutting 2 in. into the bottom of the side sill for reconditioning of side sills on refrigerator cars. The saw housing is mounted on a revolving carriage so that it can be used on either side of the car at any desired angle—The machinery is mounted on a small four-wheel truck with ball bearings which roll in any direction with the slightest effort: Fig. 7—Two-wheel truck with 12-in. automobile jack mounted for raising air-brake cylinders and reservoirs into position—The jack is operated by a 10-in. wheel fastened to the end of a jack bar—The handle is also welded onto the wheel: Fig. 8—Hoist for pressing insulation in between carlines of refrigerator cars: Fig. 9—Truck used for moving refrigerator-car side doors from station stock pile to the car

The other track is available to have empty cars spotted for scrap loading directly off the cars.

Stripping of refrigerator cars consists of removing parts due to decay, replacement by improved standards, or underframing. Material removed due to underframing would be wood sills, cross ties, truss rods and draft gears. Material removed that is to be replaced by improved standards would be the floors, floor insulation, side doors, ice bunkers and floor racks.

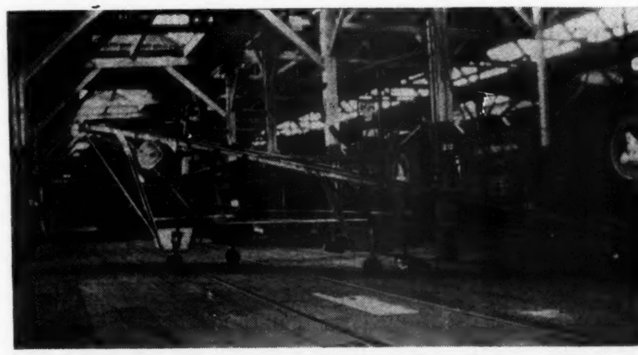
Since cars have to be handled from the stripping yard onto the repair or shop tracks with a switch engine, it is advisable to leave the two center sills and draft gears intact and cylinders hanging to the sills until the cars are set in for steel underframing. This will reduce the cost of material handling, providing draft gears and cylinders are to be re-used.

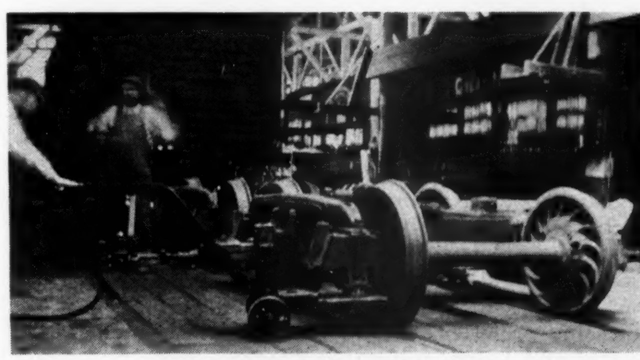
Group No. 2—Steel Underframing and Truck Rebuilding.—Two tracks of approximately 16 or 18 car lengths should be available for underframing and truck repair work with facilities rigged up and material placed about as follows: Steel underframes to be stored near the end of the tracks; train-line pipes, brackets, wood-sill nailing strips, sill steps, lever guides and floor insulation boards between tracks in the first three-car-length space; and truck material in the next three-car-length space. About 10 or 11 stripped cars may be set in one track, leaving a space of approximately two car lengths between the first car and the truck repair station.

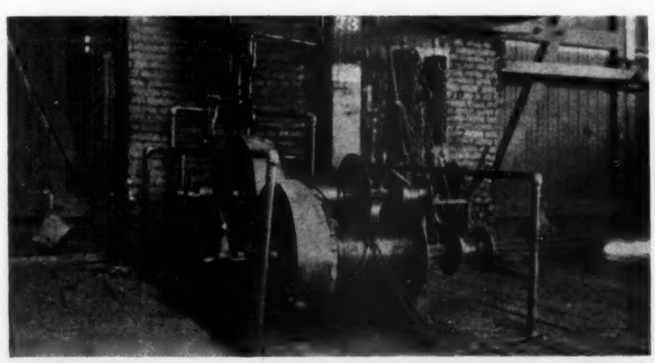
Work is to be started on the first car from a truck station and should progress towards the opposite end of track in the following manner: The first crew of men is assigned to drop couplers, draft gears and air brake cylinders. As soon as this work is completed, a second crew is started to jack the cars up and place them on trestles high enough to allow trucks with bolsters and sills to pass under the end sills safely, following the draft crew in the same direction.

As soon as the car is jacked up, the trucks, with body bolsters and sills, are pulled out from under the car and moved towards the space between the truck station and the first car, where sills, draft members, and body bolsters are unloaded. Immediately the third crew is starting to recondition the body of car for steel underframing and the fourth crew to renew defective parts of the superstructure as found necessary to renew prior to replacing the frame under the car. These four crews move from car to car with tools and most of the material they use, and are also assigned to do the same work when the frames return to the cars; namely, the crew removing draft gears and couplers are re-applying them while the men jacking up cars are jacking bodies down, and so on. Their work is in continuous order, because when the draft gears on last car, first track, have been dropped, the first car on the second track is ready to be jacked down, the draft gears applied, and so on.

As soon as wood center sills, inter sills and body







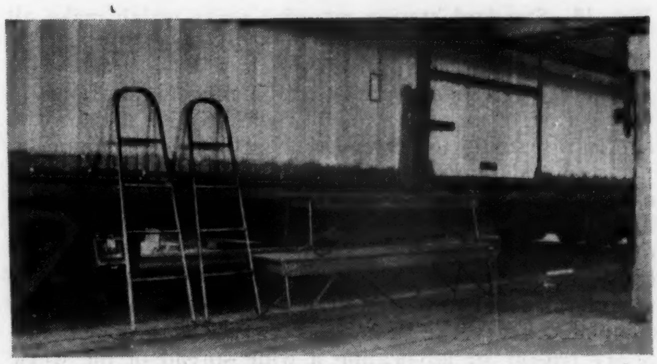


Fig. 10—(Top) Conveyor used in disposing of truck scrap: Fig. 11—One of the self-clearing scrap-wood trailers used in the striping yard: Fig. 12—Nut removing machine in operation—This machine was found to be faster than burning off column and oil-box bolts with a cutting torch: Fig. 13—Car spotting hoist mounted at one end of the shop—Approximately 3,000 ft. of cable is attached to each end of these machines: Fig. 14—Standard ladders and benches used in rebuilding refrigerator cars—The ladders are built of ¾-in. and ½-in. pipe, and the benches of ⅜-in. pipe and wooden platform—The benches are used inside the cars for ceiling work

bolsters have been removed from the trucks, the trucks are stripped, scrap loaded up and trucks re-assembled in the truck station and moved in the direction of the steel underframes. When the last car set is assembled, steel underframes are loaded on all the trucks. The first truck with frame is then moved back toward the work stations and train line and brackets are applied at the first station; then to the next station to have wood nailing strips and floor insulate boards nailed; then to the third station to have all lever guides, fulcrums, sill steps and grab irons riveted and side-bearing clearance adjusted; and finally pulled back under the car, body let down and bolted. Cars are then pulled off the track and held in reserve storage on one end of the rebuilding track

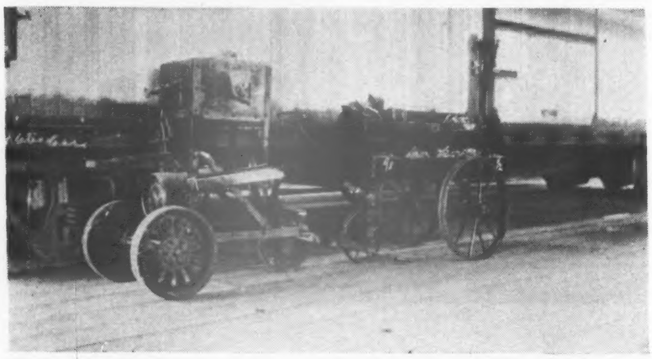


Fig. 15—Portable rivet heating forge and rack used in refrigerator car work

from which they are pulled into the stations at regular intervals.

Group No. 3—Rebuilding—One track approximately 18 car-lengths is sufficient, although if two adjacent tracks are available the progress will be considerably smoother. The work comprising the entire rebuilding should be divided into as many stations as possible. If track is of sufficient capacity to divide it into 18 stations, my preference would be to establish 14 active, 3 reserve and 1 final inspection station.

Fig. 16—Standard station material racks which make all necessary small material readily available

The three reserve stations are of much importance in taking care of all of the above work, because if the average run of siding to be removed is 80 per cent, lining 60 per cent and side or end insulation 40 per cent, and if a car happens to be pulled in requiring all new siding, lining or insulation, the work could not be completed during the regular time allotted between spotting, because the man-hour assignment is based on the average run of work, therefore, the balance of the work has to be completed in reserve stations by a reserve crew.

My reason for advocating a wide spread of the work is to avoid congestion of material and men as much as possible, affording thereby greater freedom for action. Reducing the actual use of hand tools at stations to the lowest possible degree will expedite movements remarkably, because if men have to use wood chisels, planers, augers and hand saws frequently to fit the material, much time is lost, especially where necessary for two men to work together. One will do the fitting while the other has to wait, a thing which most men resent very much under the progressive system.

As an illustration, it would appear that fitting of boards to the ceiling, side and end of the car would call for considerable sawing and measuring due to the many different lengths that have to be used for proper staggering of joints. But if all are cut to proper lengths at the mill and delivered to the car properly numbered, the going is entirely different and no offals to put up with at the station.

False floors, hatch covers, roof platforms, hatch plugs, hatch frames and side doors should be repaired or built new by a separate organization and delivered to the cars ready to apply. My preference is to have all these items assembled or repaired at the wood fabricating shop if floor space is available for a proper assembly of forms or jigs for each of these items.

Refrigerator Car Doors Fitted Before Assembly

In my opinion the fitting and weather stripping of side doors into side door posts, headers and thresholds is of vital importance and presents a difficult problem, or, I might say, requires more careful attention than any other part of work on the entire car. For that reason I believe that best results can be obtained when repairing or building new doors by fitting them into the side door posts, thresholds, and header frames, applying insulation, weather stripping, hinges, lock bars, and all other fixtures to the doors right on the shop floor and delivering the entire door assembled to the car intact with doors

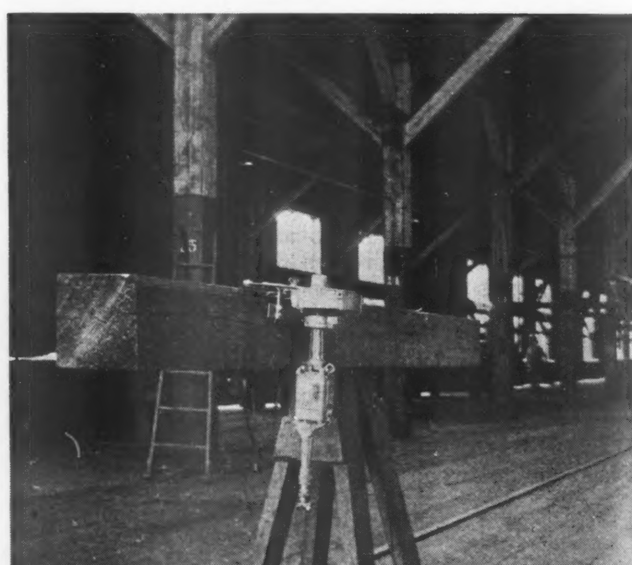


Fig. 17—Method of cutting out the crevice and side sills at the upper edge of the sills on refrigerator cars by the use of ordinary air motor grinding machine with wheel removed and a dado head mounted in its place

closed and fitted as they would be when in actual service.

Any progressive system process in assembling the above items will prove satisfactory. For instance, one set-up consists of three forms or jigs for building the left side doors, three for the right side doors, and three for assembling of side-door posts, thresholds and header frames; placing these nine forms on the shop floor in a T-shape so that the three-door posts and threshold frame forms make up the vertical bar of the T-shape and the side-door forms the horizontal bar. The construction or rebuilding of the left door commences in the first form left and the right door in the first form right. One or more men is assigned to each form to do certain parts of the work and when completed slide the door into the next form towards the center frame. When the door-post frame with all required insulation and weather stripping is completed the doors are slid into the frame, and frame with doors are slid into the next form and so on until all fixtures and insulation have been applied and the doors closed and locked. The assembled door can be handled and delivered to the station with perfect safety in a vertical position. If light jib cranes are available the handling will prove very simple through a device gripping the bottom portion of the hinges. If the device is hooked onto the bottom of the upper hinges, the doors will retain an almost vertical position.

When setting doors into place on the car the upper ends of door posts are placed in position, doors and side plates lifted sufficiently to allow the bottom end of the posts to slip into the pockets. This operation can be made very simple by the use of an air cylinder hoist.

It is my belief that under the progressive systems best results are obtainable through a maximum spread of the work because of the skill the men will develop by specializing in a limited number of moves and variety of work, and it is entirely practical to establish more than one division of work at each station especially when shop-track car capacity is limited. In the latter case, arrangements should be made for storing material overhead for all items required for rebuilding roofs. This will relieve congestion on the shop floor.

Fig. 18—Pressure gun used in cementing side and end angles on refrigerators and other cars

Avoid Repeated Jacking of Cars

I believe it is entirely practical to arrange the work under the progressive system so as to avoid repeated jacking or raising of car bodies off the trucks in order to complete the necessary work to car bodies. When steel hopper, ore, or Hart convertible cars are to be rebuilt we usually find considerable work around the bottom and sides of the hoppers requiring either patching, renewing, or straightening of sheets, frames, and hopper doors. Due to the nature of this work, maximum freedom for action and ease of getting at the work is essential if worthy workmanship and efficiency means anything. Therefore, in most cases it will be necessary to keep trucks out from under and the car bodies raised high enough to provide best conveniences for workmen. The volume of this work is far greater than can be completed in one station between moves and the car has to be moved through several stations to complete all of the work. Unless some means were adopted to avoid jacking down and again raising of the car body for each move, considerable time would be lost.

By arranging the work approximately in the following order the performance will be simplified: Repairs to trucks to be completed at the first station and the car body let down on saddles fitted over inside oil boxes. Saddles can be made of any suitable height and can be placed under the side sills or end sill, or a timber can be laid across and the car body let down. This will leave the entire truck out from under and the car can be spotted in the regular way at any station and the work continued without interruption. Draft sills, body bolsters, or end sills can be renewed while the body is suspended on saddles by the side sills, provided, of course, the car has side sills.

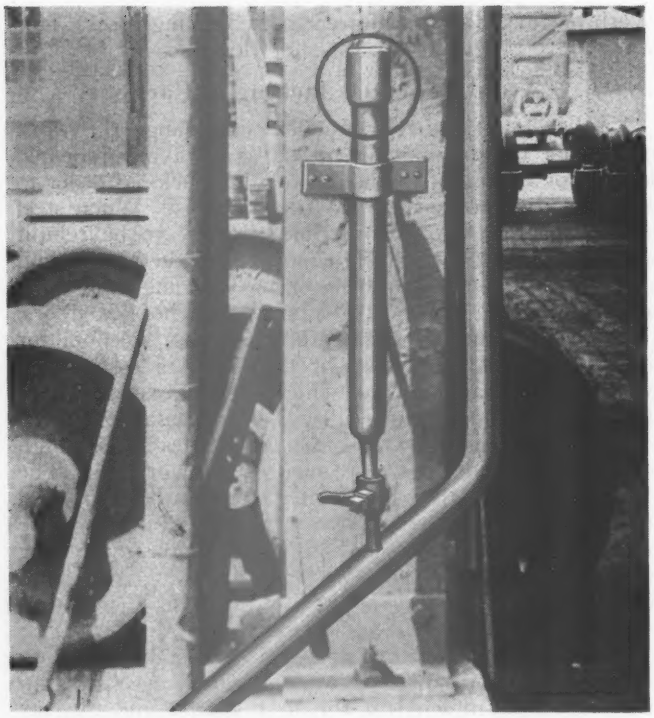
Painting

The painting of cars should be arranged so that the first coat is applied immediately after the car is released from the rebuilding station, and the second coat as soon as the first coat is sufficiently dry, avoiding delays and the necessity of switching cars over to other tracks, because much shop space has to be sacrificed under a fairly large daily production program if all moves of the cars throughout the entire plant are not expedited.

Eliminating Frozen Shop Air Lines

DELAYS are frequently experienced, especially in the northern sections of the country, due to shop air lines freezing during the winter months. It is therefor necessary to apply anti-freezing solutions at various points in the lines in order to prevent the freezing of condensation and in many shops this is done by merely disconnecting the air hose at the point where it is being used by the workmen, pouring in alcohol or other anti-freeze preparations and permitting it to flow back into the line. While this practice assists in eliminating the freezing of the condensation in the immediate vicinity of the line where applied, it consumes considerable time and is not as efficient as that of applying an anti-freeze solution at the source of the air supply and at suitable intermediate points in the air line.

A better arrangement consists of a device which is attached at various points in the air line and which will



A simple arrangement for injecting anti-freeze solution into air lines

permit the application of anti-freeze solutions without disrupting the operation of the shop. A 2-in. pipe is welded or tapped into the main air line, a cut-out cock being inserted at the bottom connection. The pipe cap at the top can be removed after the air has been shut off and about 2 qts. of alcohol or anti-freeze applied. After the cap has been securely replaced and the air cut in, the solution will flow into the main line and mix with the condensation, thereby preventing it from freezing. It is recommended that these anti-freeze supply pipes be installed at all low points in the air line as well as at the air storage tank connections.

Securing Sway Hooks In Auto Box Cars

SEVERAL cases of damage to automobiles loaded in automobile box cars equipped with loading and unloading devices has occurred in the past few months due to the loading devices swaying back and forth and either bending or breaking the supports, thus permitting the automobile to drop down and come in contact with the automobile on the car floor below it. An investigation by one railroad developed the fact that the sway hooks attached to the side of the car and which engage the frame of the loading device were becoming dislocated in transit. The original construction of the unloading devices provided for a flat steel spring welded to the frame above the opening where the sway hook engages. In some cases this spring had lost its tension and in other cases it had been broken off, thus permitting the hook to work out of place.

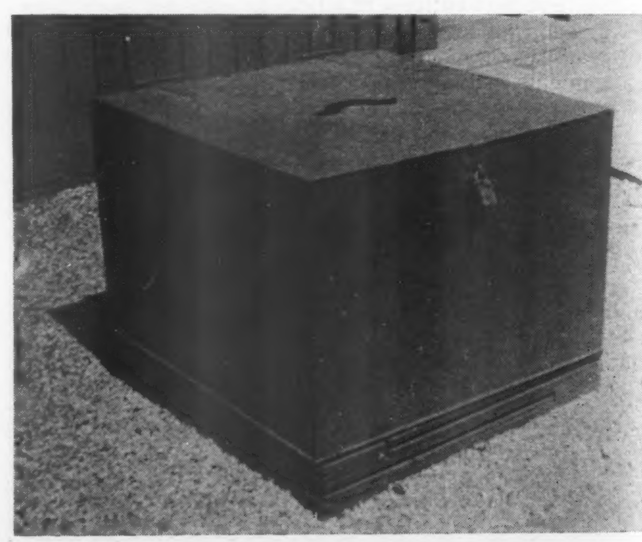
By drilling a small hole in the bottom of the sway hook, as shown in the illustration, and inserting a hook attached to a light chain the sway hook cannot become disengaged from the frame and such damage as above related will be eliminated.

Adding a retaining hook and chain prevents dislocation of sway-hook pins

Container for Storing Scrap Journal Bearings

ON light car-repair tracks where the material delivery system is not in effect, due to the small amount of material required in the general run of repairs made, the practice of having the mechanic leave his car and return the old journal bearings to the storehouse would result in considerable loss of time. The value of the old bearings makes it necessary, however, that they be protected from theft until a sufficient supply has accumulated to warrant loading them.

The container shown in the illustration was designed by a car foreman on one railroad who placed them at various points in and around the shop where they were accessible to the repairmen and to the supply track for periodical collections.



Container permits the accumulation of a sufficient number of old bearings to warrant collection

The container is made of ¼-in. sheet steel, welded on the sides and bottom, and is approximately 4 ft. square. The cover is attached by either welding or riveting hinges to it and a hasp and staple is provided to permit the application of a lock. An opening of sufficient size to accommodate a 6 in. by 11 in. journal bearing is provided in the cover as shown through which the worn out journal bearings are dropped into the container.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Wheel with 2-in. Flat Spot Credited as Second-Hand when Removed with Mate Wheel Worn Through Chill

The Florida East Coast applied a pair of new wheels on a Seaboard Air Line car on account of one wheel worn through the chill and the mate wheel slid flat 2 in. Both wheels were scrapped at owner's expense. The S.A.L. contended that second-hand credit should be allowed for the slid-flat wheel to which F.E.C. did not agree and the case was appealed.

The S.A.L. stated that the case was not presented to decide correctness of defects shown, but they believed it extremely improbable that a wheel condemnable for worn through chill when slid to the extent of developing a 2-in. flat spot on the mate wheel would not itself develop a 2½-in. spot. They contended that second-hand credit should be allowed for a wheel with a 2-in. flat spot. The F.E.C. in refusing adjustment based their action on paragraph 164 of the Wheel and Axle Manual, there being no provision in the A.A.R. rules that provides for scrapping a slid-flat wheel at expense of car owner except where covered by car owner's defect card and then only when there exists a flat spot 2½ in. or two or more adjoining spots, each 2 in. or more in length. In the dispute there is no defect card involved and the S.A.L. feels that if the F.E.C. desires to scrap a wheel with a 2-in flat spot they must do so at their own expense and allow the car owner second-hand credit.

The F.E.C. rendered the bill on the basis of both wheels removed being scrap, to which the S.A.L. did not agree, claiming the Wheel and Axle Manual did not govern as it is only recommended practice. The F.E.C. claimed that charge rendered was correct, based on the fact that the note preceding Rule 68 makes the content of paragraph 164 of the Wheel and Axle Manual the deciding factor.

In a decision rendered November 8, 1934, the Arbitration Committee said; "Since Rule 68 requires a wheel to have a slid flat spot of 2½ in. or over in length, or two or more adjoining spots each 2 in. or over in length, to be condemned, and the rules contain no remount shop limit for lesser flat spots, the contention of the car owner is sustained."—*Case No. 1737, Rule 68, Seaboard Air Line vs. Florida East Coast.*

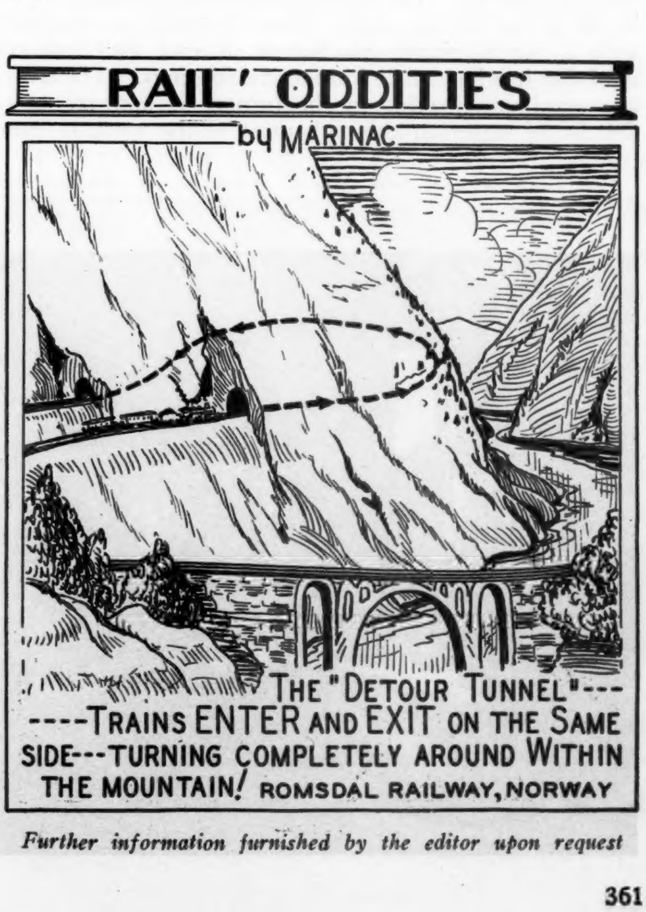
Air-Brake Hose Condemned by Visual Inspection Prior to August 1, 1934

The Reading had been billing the Western Maryland since July, 1933, with an unusual number of air-brake hose applied to W. M. equipment, showing cause of removal of old hose as being due to seamed, fabric cracked, spiral cracks and soft bends. Correspondence developed that the Reading had adopted a system of removing air hose by visual inspection alone, claiming that this practice was supported by maintenance rule 46, Instructions Covering Air-Brake and Air-Signal Equipment on Locomotives and Cars. The W.M. considered that while rule 46 provides for visual inspection, it does not permit condemnation unless the proper test as provided elsewhere in the maintenance rules shows that the hose failed to meet the required test, the proper test being the soap-suds test as provided by maintenance rules 101 and 106. On this point an appeal was made.

The Reading acknowledged removal of an average of 55 hose monthly from W.M. cars on account of seamed, fabric cracked, spiral cracks and soft bends—all condemnable defects under A.A.R. Rule 56. The number was not considered excessive, considering the average monthly car days of W.M. cars on Reading lines as 15,000. The Reading was of the opinion that A.A.R. Rule 56, had been inserted in interchange rules to clarify intent of Rule 46 governing maintenance of air brakes rather than to institute a new practice.

The Western Maryland contended that A.A.R. Rule 56 cannot be considered as retroactive to cover unsettled cases. Attention was called to the large number of hose removed during the period July, 1933, to July, 1934, hose being removed by visual inspection only and not subject to any test prior to removal. The W.M. contended that this practice is contrary to provisions of A.A.R. rules and that removal of hose by visual inspection alone is contrary to the intent of maintenance rule 46 and that hose should be removed only after being tested as provided for in maintenance rules. It was contended that this practice left too much to the inspector's judgment. They felt that hose should not be removed unless they proved defective after being given proper test and that refunds should be made for hose removed by visual inspection.

In a decision rendered November 8, 1934, the Arbitration Committee said: "Car owner is responsible for the enumerated defects in air hose found by visual inspection. The contention of the Reading Company is sustained. (Effective August 1, 1934, Rule 56 covers.)" —*Case No. 1738, Rule 56, Reading vs. Western Maryland.*



Further information furnished by the editor upon request

In the Back Shop and Enginehouse

The Use of Gas Heat In Railroad Shops*

THERE are many operations in locomotive and car repair work where gas for heating purposes is used extensively. In the forge shop, particularly, several different types of gas furnaces are used in connection with forging operations, and the installations described in this article are in service in a midwestern repair shop.

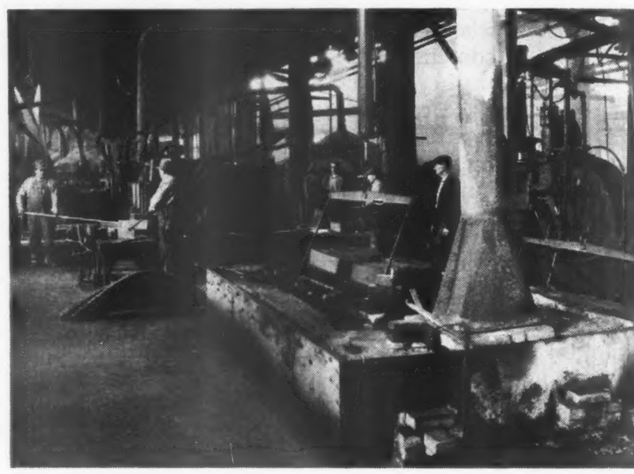
The majority of these furnaces are brick and steel construction. A typical example is a hammer furnace with a 44-in. by 34-in. hearth which is loaded and unloaded through two doors in one side and fired by means of two gas burners of the diffusion type installed in the sides opposite the doors in such a manner that they fire across the arch and tangential thereto. This unit is used for heating billets for forging locomotive rods. Each of the billets weighs approximately 1,205 lb. and two are charged into the furnace at the same time. The billets are handled to and from an adjacent power hammer by a jib crane and hoist. The billets are heated to a temperature of from 2,500 to 2,700 deg. F., depending upon the size, and are usually soaked for almost an hour to equalize the temperature. The consumption of gas for 8-in. by 10-in. billets averages 1,150 cu. ft. per hour.

In the shop in question there are four slot-type forging furnaces, three of which have 20-in. by 40-in. by 14½-in. hearths. The fourth furnace has a hearth 15 in. by 47 in. by 13¼ in. high. These furnaces are equipped with a nozzle-mixing gas burner on each end and are used for heating small locomotive forgings. The average maximum loading of the furnace is approximately 280 lb. of material, although most of the work is done with smaller furnace charges. Furnaces of this type consume an average of 975 cu. ft. per hour.

A double spring furnace is employed to heat old spring leaves prior to banding and tempering. The hearth in this furnace is 5 ft. by 9 ft. and is 14½ in. high inside. Double doors are located on opposite sides of the furnace so that two operators can use the two halves of the heating chamber without interference. These furnaces are, as a rule, charged with approximately 250 lb. of steel and with this charge the gas consumption amounts to approximately 800 cu. ft. per hour.

Bands on old springs are heated for removal in an open-flame type furnace, 15 in. by 22 in. by 15½ in.

* An article prepared from material secured by the American Gas Association.



Double forge furnace for heating spring leaves for two crews, with annealing pot in foreground—Both gas fired

A hammer crew at work—The billets are heated in the gas-fired forge furnace shown at the right

Gas burner with which locomotives are fired in the shop preparatory to going out on the road

Pouring bronze castings—Gas-fired soft metal melting furnace and ladle heat in background

high. This type of furnace is open at both sides and is fired by a gas burner from one end. The gas consumption is approximately 650 cu. ft. per hour.

A rectangular gas-fired, cast-iron pot is also used in connection with spring work. The pot, 4 ft. 6 in. by 6 ft. 9 in. and 1 in. thick, is mounted in brick work and is used for heat-treating spring leaves. No combustion space is provided and a diffusion-type burner fires directly into the space around the pot. The leaves are handled in a metal basket suspended by a hoist from a jib crane, and the spring leaves are heated in a special compound to a temperature from 480 to 600 deg. F. From 200 to 680 lb. of spring steel is heated in this type of annealing pot at one time, and the average gas consumption is 500 cu. ft. per hour.

The ends of boiler tubes are heated for swaging in a small furnace 18 in. by 35 in. by 18 in. high inside, fired from one end with a single nozzle-mixing gas burner. The tube ends are thrust in through a side opening close to the end opposite the burner. Both small boiler tubes and superheater flues are heated in this type of furnace.

A boiler-plate furnace, with a hearth 12 ft. 9 in. by 14 ft. 3 in. and 3½ ft. high from hearth to the crown of the arch, is used for heating boiler plate for forming and is fired with three diffusion type gas burners—two large ones for heating up the furnace rapidly and a small one for holding the heat. All the burners are located on one side. The weight of the steel charged into this furnace varies from one-half to five tons, and the gas consumption amounts to approximately 3,600 cu. ft. per hour.

Annealing and Heat-Treating Furnaces

Among the heat-treating furnaces is one employed for carburizing with a hearth 31 in. by 60 in. by 30 in. high. Steel parts to be carburized are packed in boxes or pipes, and the furnace is of sufficient capacity to heat approximately 620 lb. at one charge. The gas consumption of a furnace of this type with the above-mentioned charge is approximately 1,000 cu. ft. per

A row of gas-fired forge furnaces

hour. An annealing furnace 34 in. by 50 in. by 22 in. high has a capacity of 350 lb. of metal and consumes 900 cu. ft. of gas per hour through a single diffusion burner.

Among other installations in which gas is used is a two-pot babbitt furnace employed for melting babbitt for bearings and lead for driving-wheel counterbalances. This furnace is 28 in. by 60 in. by 32 in. high and is fired by two nozzle-mixing gas burners. With a capacity of 500 lb. of lead the gas consumption is approximately 450 cu. ft. per hour.

In the brass foundry there is a melting furnace of the horizontal cylindrical type mounted on standards for rotating which is used for melting brass for journal bearings, rod bushings, etc. This type of furnace is charged with approximately 1,500 lb. of metal. The heat is supplied through a single nozzle-mixing gas burner firing through one end and just above the charge. Other uses for gas around this shop are for tire heating, rivet heating and for gas cutting.

Riveting crew using portable gas-fired rivet heater and a natural gas torch for cutting out old rivets

In the enginehouse locomotives are fired by means of a long-handled gas burner. By means of this burner a locomotive may be fired and sufficient steam raised to move the locomotive under its own power in approximately 25 min. This firing burner consists of an 8-ft. handle composed of 1½-in. air pipe and 1-in. gas pipe ending in a manifold 4 in. in diameter and 8 in. long. To this are welded several short lengths of ¾-in. pipe which serve as nozzles. Air is supplied at 7 lb. pressure and gas at 2 lb. pressure.

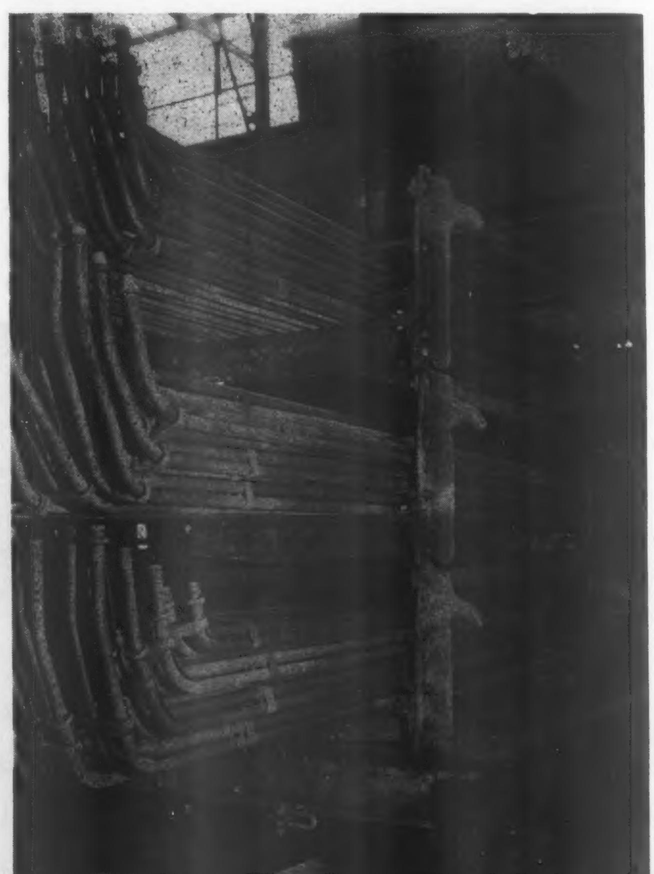
In this particular shop gas of 1,050 B.t.u is delivered to the burners at an average cost of 45 cents per 1,000 cu. ft.

Questions on Locomotive Design and Maintenance

THE following list of questions, submitted by a reader, offers an opportunity for locomotive designers and mechanics to test their knowledge on a number of subjects with which they come in contact in every-day work. The editor will welcome replies from readers of this section giving their version of the answers to these questions. The correct answers will be published in the October issue of the *Railway Mechanical Engineer*.

The Questions

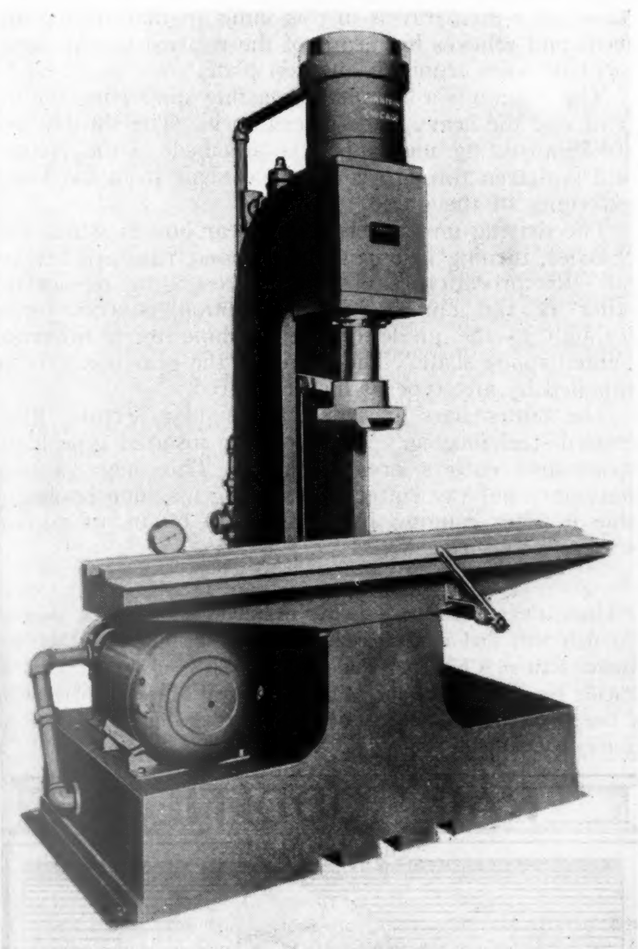
1. Why is the main throttle valve of a locomotive designed with two seats?
2. To test an air pump for capacity a 3/32-in. orifice is required. In the absence of a 3/32-in. drill could the same results be obtained by drilling two holes, one 1/16 in. in diameter and the other 1/32 in. in diameter?
3. What would be the effect of turning a pair of locomotive main drivers right for left?
4. Which wears the more rapidly, the top or bottom of a locomotive crosshead?
5. Why are locomotive hub liners usually laid out with six holes rather than five, seven or eight holes?
6. Would it be practical to lay out the 36 equally spaced stud holes in a cylinder head by stepping around the stud circle with dividers set to the specified distance between two studs?
7. Why is a brass joint ring for steam pipes impractical?
8. What fittings about a locomotive boiler do not have a standard boiler thread of 12 threads per inch?
9. Does any steam get into the steam gage during the operation of a boiler?
10. In applying a globe valve, one side of which is subject to boiler pressure, should the valve be placed so that the stem packing is exposed to this pressure when the valve is closed? The "blow down" valve on top of a locomotive boiler is an example.
11. Why is any sort of by-pass valve unnecessary on old style flat slide-valve locomotives?



Push car and special stacked racks used for the convenient movement and storage of superheater units at the Chicago shops of the C. & N. W.

Sensitive Straightening Press

A NEW type of 35-ton hydraulic press, especially designed for straightening operations on axle shafts, crankshafts, and similar work requiring accurate straightening has been developed by Hannifin Manufacturing Company, 621-31 South Kolman avenue, Chicago. The press, notable for its ease and flexibility of operation, is well adapted in the railway field for apply-



Hannifin 35-ton hydraulic straightening press

ing the smaller rod bushings, brake rigging bushings, spring rigging bushings; straightening valve motion parts, etc.

Simplified handling of straightening operations and increased production are features resulting from the exclusive design of the control mechanism of this press. A single lever controls the entire operation of the ram, with an extremely sensitive proportional control action. When the control lever is moved in either direction the ram will move a proportional distance and then stop by automatically bringing the operating valve to neutral. Thus the operator, merely by moving the one operating lever, obtains a ram movement at 35 tons pressure through the exact distance required for the straightening of any piece. An accurate ram movement, either up or down, of as little as $1/16$ in. may be obtained. The arc of movement of the control lever is approximately three times the ram stroke, providing for sensitive handling without requiring the development of special skill on the part of the operator.

The hydraulic power unit, with constant-delivery type rotary pump, is built into the base of the press, making a self-contained unit that requires approximately 19 sq. ft. of floor space. No separate hydraulic power is required, thus simplifying the installation and making operation unusually economical.

The ram delivers 35 tons pressure, and may be fitted with any type of fixture required for handling the parts to be straightened. The ram stroke is 6 in. The speed for the power stroke is 53 in. per min., and for the return stroke, 77 in. per min. The dimensions are: Table to ram (up), 20 in.; center of ram to face of frame, 9 in.; length of table, 70 in.; floor to table, 36 in.; overall height, 98 in.; base, 38½ in. by 69 in.

Ladder Testing Device

A SIMPLE yet effective method of testing ladders, which is used at one of the shops of the Louisville & Nashville, is clearly shown in the illustration. It

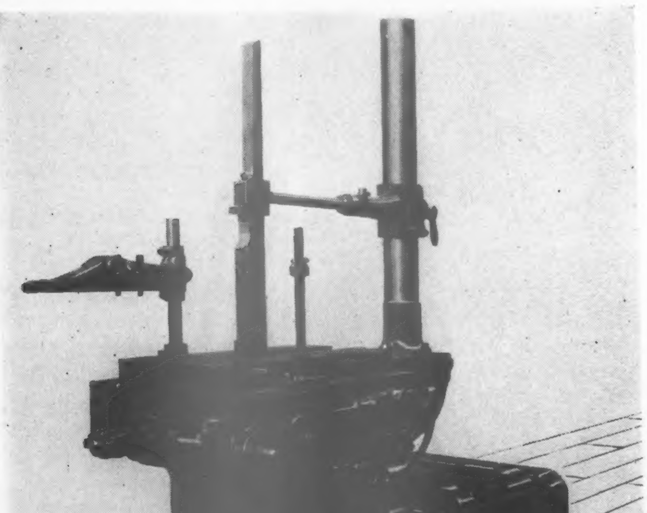
Method of testing a ladder with a 450-lb. anvil hung from each rung from the top to the bottom

consists simply of suspending an anvil, which weighs about 450 lb., from the ladder by means of a single-sheave pulley and rope with a substantial double-chain

connection to the front and back ends of the anvil. The assumption is that any ladder strong enough to support the dead weight of the anvil has an ample factor of safety when supporting a man. In checking the condition of a ladder with this device, each rung is tested from the top to the bottom, the anvil being raised only slightly from the ground at each pull. The operation of changing the rope block from one rung to the next is easy, the block hook being simply dropped from one rung to the other as the test progresses.

Keyway Cutter and Slotting Machine

In the new stationary keyway cutter and slotting machine made by the Morton Manufacturing Company, Muskegon Heights, Mich., the work remains stationary. The correct adjustment for taper, depth of cut and cutting of keyways in taper bores comes in the guides, crosshead and cutter bar member. This machine consists primarily of four major units—the top plate, the guide and crosshead unit, the column and the driving unit.



Morton keyway cutter and slotting machine

The top plate is rectangular, with T slots to facilitate the use of binding bolts or other supporting means in unsymmetrical work and is bolted rigidly to the supporting column. An auxiliary top plate is used between the main top plate and the work, primarily as a protection in the handling of heavy work. This auxiliary top plate also contains jaws for centering all diameters of bores with a minimum amount of equipment.

A bracket, which contains a rotating nut and screw mechanism for feed and relief, is bolted to the front of the top plate. A locking collar provides means for setting to total depth of cut. The ratchet feed mechanism, with feeds ranging from .001 in. to .020 in. of stroke, is also attached to the top plate and is so arranged that when the cutter reaches the predetermined depth a friction slips, limiting the depth and making practical duplication of depths without resetting.

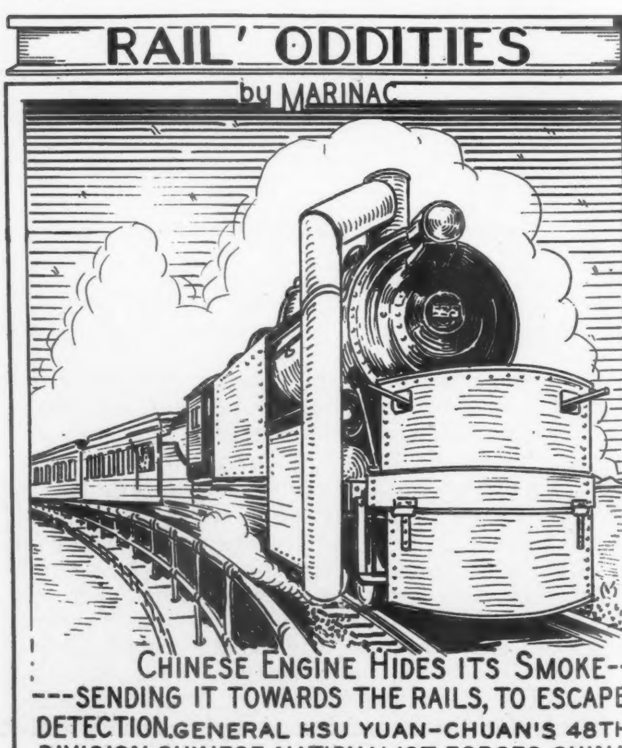
The guide contains all gearing for transmitting power to the spiral cut pinion and rack which reciprocates the crosshead and cutter bars. This guide is journaled in a special trunnion member provided with bearing surfaces which move parallel with the upper surface of the top plate. Means is provided for locking the guide to the trunnion member. The guide, crosshead and bar may thus be adjusted to any angular position with the top upper surface of the top plate up to 1 in. taper per foot. The cutter then travels in this same angular setting and feeds and relieves by means of the relative lateral movement between trunnion and top plate.

The column is a box-shaped casting supporting the top plate and the heavy loads placed on it. The shifting and stroke-adjusting mechanism is attached to the column and is driven through a universal shaft from the lower extremity of the guide.

The driving unit consists of a gear box in which two clutches, turning in opposite directions, run in a bath of oil. Reciprocation is obtained by engaging one or the other of the clutches. This motion is transmitted through to the guide of the machine by a universal jointed spline shaft. The power to the gear box may be supplied by any type of motor desired.

The cutter bars are of a rectangular section, heat-treated-steel forging. Tool slots for inserted type high-speed-steel cutters are provided. This new Morton stationary keyway cutter and slotting machine is obtainable in sizes ranging from 30 in. to 60 in. of cutting stroke.

Milwaukee Museum.—Local railroaders and those passing through will find much to interest them in Room 854 of the Union station, Chicago. The Chicago, Milwaukee, St. Paul & Pacific has just opened the Milwaukee Road Museum there, with a huge collection of objects of every sort dealing with railroad history.



Further information furnished by the editor upon request

Among the
Clubs and Associations

NATIONAL METAL CONGRESS.—The seventeenth annual National Metal Congress and exposition will be held at Chicago during the week beginning September 30, when a series of five daily lectures on the Heat Treatment of Steel will be presented by Dr. Marcus A. Grossman, director of Research of the Illinois Steel Company.

MACHINE TOOL SHOW.—Notices have been sent out by the National Machine Tool Builders' Association to exhibitors at the Machine Tool Show, which will be held at Cleveland, Ohio, September 11 to 21, inclusive, that Friday, September 20, has been designated as the special Railroad Day of the Machine Tool Show. The plan is to have as many exhibitors as wish to demonstrate the application of their tools to railway work arrange to have them tooled up and in operation on that day. It is understood that a number of machine-tool manufacturers have already signified their intention of participating in this plan.

MASTER BOILER MAKERS' ASSOCIATION.—Regardless of any action that may be taken by the group of minor railway mechanical associations towards holding coordinated business meetings at Chicago in September, the Master Boiler Makers' Association is proceeding independently with its plans for bringing together as many of the officers, committee members and members of the association as is possible through permission of their respective superior mechanical officers. This business meeting will be held at the Hotel Sherman, Chicago, September 18 and 19. ¶ To the end that the meeting may produce information of real benefit to the railroads in meeting the serious problems involved in certain aspects of locomotive boiler inspection, maintenance and repair, a program of extremely practical papers is now in course of preparation by committees of the association, covering the following subjects: Boiler and Tender Tank Corrosion and Pitting, in Service and in Storage; Fusion Welding as Now Applied to Boilers and Tenders; Staybolt Leakage and Cracking of Firebox Sheets—Methods of Prevention; Application and Maintenance of Arch and Watertubes; special report of the Southern Pacific Company on Fusible Plugs.

Eastern Car Foreman's Third Annual Field Day

The Eastern Car Foreman's Association held its third annual field day and golf tournament at the Race Brook Country Club at New Haven, Conn., on July 18. Approximately 240 members and guests were in attendance. The program for that day, which was designated "New Haven Day," was sufficiently varied to be of interest to the majority of those present. Golf events and putting contests for the golfers and non-golfers, as well as quoits, bridge and numerous other attractions provided entertainment from early morning until after the dinner in the evening at 7:30 p.m. Prizes were awarded for the many events and a "Grand Mystery Drawing" at the close of the dinner brought prizes to many who had not been winners in the regular events. ¶ Of the prizes given for regular events the principal ones were as follows: Tournament Golf—Class A—Low gross, L. H. Foster; low net, J. Howland. Class B—Low gross, R. Sonquist; low net, J. Schlintz. Class C—Low gross, P. E. Pfeiffer; low net, S. L. Poorman. Kickers' prize, V. W. Ellet; low gross prize, T. M. Ferguson; putting contest for golfers—First prize, J. T. Daley; second prize, A. E. Calkins. Quoits—First prize, A. J. Pretyman; second prize, J. Wiley. Bridge Tournament—First prize, Harold Chamberlin; second prize, Lee Peabody; third prize, J. Marcuso. Putting Contest for Non-golfers—First prize, J. G. Platt; second prize, G. Allison. Hole-in-one, H. Hughes and J. L. Metz; longest drive, C. Jordan; second longest drive, J. Delahanty. ¶ The general arrangements for the outing were under the direction of J. P. Egan, president of the association; F. H. Becherer, general chairman; A. E. Calkins and R. Sonquist, vice-chairmen, and 11 committee chairmen.

Directory

The following list gives names of secretaries, dates of next regular meetings and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, c/o Westinghouse Air Brake Company, Thirty-fourth Floor, Empire State Building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

ASSOCIATION OF AMERICAN RAILROADS.—J. R. Downes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

DIVISION I.—OPERATING.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

COMMITTEE ON RESEARCH.—H. A. Johnson, chairman (Director of Research, Association of American Railroads), Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION VIII.—MOTOR TRANSPORT.—CAR SERVICE DIVISION.—C. A. Buch, Transportation Building, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, 192 East Cedar street, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—G. F. Nordenholt, 330 West Forty-second street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony Building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 West Wabasha street, Winona, Minn.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Business meeting Hotel Sherman, Chicago, September 18 and 19.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

Group in attendance at the third annual field day of the Eastern Car Foremen's Association at New Haven on July 18

Further information furnished *by the editor upon request*

NEWS

THE CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA has awarded a contract for the construction of a 15-stall enginehouse at Itasca, Wis., to the James Leck Company, Minneapolis, Minn.

THE UNION PACIFIC is planning to convert 25 Mallet compound locomotives into single-expansion engines; to rebuild and install loading devices in 500 automobile cars, 250 of which have already been completed, and to rebuild 1,970 box cars.

G. T. W. Rebuilding Shop

THE GRAND TRUNK WESTERN has awarded a general contract to the Austin Company, Detroit, Mich., for the erection of a structural steel building at Port Huron, Mich., to replace that portion of a freight car repair shop at that point which was destroyed by fire on January 9, 1935. The new portion of the building will have a length of 500 ft., a width of 82 ft., and a side section 160 ft. long and 28 ft. wide. It is to be constructed of structural steel removed from the company's car shop building at Elsdon, Ill. The exterior walls will consist of insulated metal siding with new steel sash, while the roofing will consist of asphalt on a wood deck. In addition to the usual mechanical and electrical equipment and heating facilities, the structure will be equipped with a 7½-ton traveling bridge crane. The new structure is to be used for the repair of steel freight cars, while the undamaged portion of the shop is to be used for making repairs to wooden equipment. The reconstruction of this shop will cost about $100,000.

New Light-Weight Car on Swiss Railroads

THE SWISS FEDERAL RAILROADS have recently introduced a new type of light-weight, streamlined, electrically-propelled car designed to provide more frequent and faster passenger service. The car is 70.5 ft. in length and weighs 32 tons; it is air-conditioned and has a capacity for 70 passengers. Trial trips during May demonstrated that the vehicle could negotiate curves at a speed of from 43 to 50 m.p.h., while a maximum speed of 87 m.p.h. was attained on straight stretches.

Express Refrigerator Car for Veal Shipments

A NEW type express refrigerator car and improved express-car service from the northern part of Wisconsin to Chicago and Milwaukee is being tried on the Chicago & North Western in an effort to recapture veal shipments from truck competition. The car is the first to be used for shipments of this kind and is designed to protect veal while being moved from the dairy districts to Chicago and Milwaukee and insure top market prices.

Hooks for 144 animals are provided in the car so that the carcasses will not be piled on top of each other. The cars carry about five tons of ice for each trip. Other perishables, such as dairy products, may also be carried in the car.

J. M. Hall Appointed Chief Inspector of Locomotives and Boilers

PRESIDENT ROOSEVELT on July 18 sent to the Senate the nomination of John M. Hall, assistant chief inspector of locomotive boilers, to be chief inspector, succeeding Alonzo G. Pack, who has held the office since July, 1918, and who is retiring under civil service rules at the age of 70. John Brodie Brown was appointed assistant chief inspector succeeding Mr. Hall.

New York Central Lines Become New York Central System

THE group of railroads heretofore known as the New York Central Lines will henceforth be called the New York Central System, according to a recent announcement made by President F. E. Williamson. The new name replaces one which has been in use since 1914, when the New York Central & Hudson River, with several other lines, was consolidated into the New York Central Railroad Company. The change of name on locomotives, cars and other equipment will be made over a period of time as the equipment is repainted, repaired or replaced.

(Turn to next left-hand page)

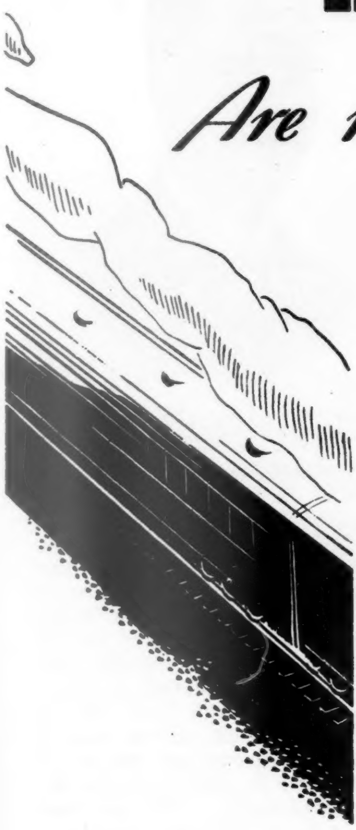
Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of system	Builder
D. & H.	1	Parlor-cafe	....	Rails Co.
N. Y. C.	11	Dining	....	Airtemp, Inc.*
Pennsylvania	4	Dining	....	Airtemp, Inc.*

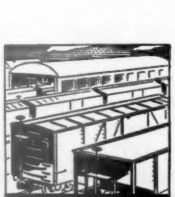
* Distributors for air-conditioning products of Chrysler Motors.

ALLOY STEELS

Are removing old limits of design



New life is being injected into the steam locomotive. » » » Weights are being lightened, speeds increased and the old iron horse is being rejuvenated to meet the new demands of rail transportation. » » » Designers now have new materials to work with. » » » Many of the limitations of material that have hampered locomotive designers have been removed by the alloy steels and irons developed by Republic Steel Corporation. » » » Agathon Nickel Iron has a glass-hard surface to resist the wear encountered at high speeds combined with a tough core to withstand the increased shocks. Here is a better material for pins and bushings. » » » Agathon Engine Bolt Steel takes the stretch out of engine bolts and helps keep bolted parts tight at the higher speeds. » » » In addition, Toncan Iron Firebox Sheets and Agathon and Climax Staybolts withstand the harder working of the firebox, while special alloys give added strength and toughness to axles, rods and other vital parts. » » » And now—the latest development—Republic Double Strength Steels combine great strength, light weight and high corrosion-resistance in the ideal metal for the transportation industry. » » » When building new power consult with Republic on the latest developments in materials. » » » » » » » » »



ROOFING SHEETS CAR SHEETS and sheets for all purposes are made by Republic in steel, Toncan Iron and special analyses.

Republic Steel

CORPORATION

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

GENERAL OFFICES: YOUNGSTOWN, OHIO

New Equipment

CAR ORDERS

Purchaser	No. of Cars	Type of car	Builder
Board of Transportation, City of New York	250 [1]	Steel pass.	American Car and Fdry. Co.
	5 [1]	Motor trucks	
	5 [1]	Trailer trucks	
	250 [2]	Steel pass.	Pressed Steel Car Co.
	5 [2]	Motor trucks	
	5 [2]	Trailer trucks	
Norfolk Southern	500 [3]	40-ton box	Pullman-Standard Car Mfg. Co.

CAR INQUIRIES

Chesapeake & Ohio	100	Auto box	....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Chesapeake & Ohio	5	4-8-4	Lima Locomotive Works

LOCOMOTIVE INQUIRIES

Lung Hai Ry. (Chinese Nat'l Rys)	10	4-6-2	....

MISCELLANEOUS ORDERS

Road	Type of equip.	For use on	Order placed with
Can. Nat'l	Bearings [4]	Engire trucks of four 4-8-2 locos.	Timken Roller Bearing Co.

[1] To cost $9,613,400.

[2] The Pressed Steel Car Company must assign 150 cars and the trucks of this order to the Pullman-Standard Car Manufacturing Company. Pressed Steel is to receive $3,824,000 for the 100 cars it will build and the Pullman-Standard Car Manufacturing Company will receive $5,789,400.

[3] The P. W. A. has allotted $1,040,000 toward the purchase of this equipment.

[4] To be installed in railroad shops.

Supply Trade Notes

HARRY O. AMES, formerly associated with the Crane Company, Chicago, has been appointed representative of Rawlplug Company, Inc., New York, with headquarters at Oklahoma City, Okla.

WILLIAM S. MORRIS, representative of the American Locomotive Company, with headquarters at Chicago, has been appointed district sales manager in charge of the Chicago office. Mr. Morris was born on March 21, 1900, at Richmond, Va., and graduated from the U. S. Naval Academy at Annapolis in 1922. He entered the employ of the American Locomotive Company in October of that year as a special apprentice at the Schenectady Works. In 1925 he was transferred to the sales department of the accessories division, with headquarters at New York, and in 1926 was appointed sales representative at Chicago.

Moffett Studio

William S. Morris

THE AIR CONDITIONING DEPARTMENT of the Westinghouse Electric & Manufacturing Co. has been transferred from East Pittsburgh, Pa., to Mansfield, Ohio, where it becomes a part of the Merchandising Division. This transfer affects all sales, engineering and manufacturing activities of the Air Conditioning Department, its purpose being to effect a closer co-ordination, particularly in the design and manufacture of air-conditioning equipment with the other closely allied products now within the scope of the Merchandising Division. S. F. Myers will continue as manager of air-conditioning sales.

JOHN E. LONG, mechanical engineer of the Franklin Railway Supply Company, Inc., with headquarters at Chicago, has been appointed assistant to the vice-president at the Chicago office. Mr. Long was born in 1899 and was graduated from Purdue University in 1923. Prior to his graduation he was employed in various capacities by the Pennsylvania, the Baltimore & Ohio, and the Atchison, Topeka & Santa Fe. In 1923 he entered the service of the Lima Locomotive Works, Incorporated, remaining with that company for 11 years. While with Lima, Mr. Long was in the calculating, service, engineering and sales departments and had an extensive experience in special design work and in locomotive testing. He also engaged in the study of operating conditions on various roads with a view to applying the most efficient designs of locomotives to the specific operations. Mr. Long was appointed mechanical engineer of the Franklin Company in June, 1934.

John E. Long

Personal Mention

General

M. F. BROWN, fuel supervisor of the Northern Pacific, has been assigned to Livingston, Mont., and territory east.

M. A. DALY, fuel supervisor of the Northern Pacific, has been assigned to Parkwater, Wash., and territory west.

H. A. FINBERG, assistant fuel supervisor of the Northern Pacific, has been assigned to Livingston, Mont., and territory east.

M. B. MORROW has been appointed fuel supervisor of the territory of the Northern Pacific between Livingston, Mont., and Parkwater, Wash., with headquarters at Missoula, Mont.

H. C. HUFFMAN has been appointed mechanical foreman of the Kansas City Southern, with headquarters at DeQueen, Ark.

HENRY YOERG, superintendent of motive power of the Great Northern, who has been appointed general superintendent of motive power, with headquarters as before at St. Paul, Minn., as announced in the July *Railway Mechanical Engineer*, entered the service of the Great Northern on May 1, 1897, as a draftsman, with headquarters at St. Paul. In 1902 he was appointed superintendent of shops at Havre, Mont., and about a year later was transferred to St. Paul. In 1908 he became mechanical engineer; in 1917, assistant superintendent of motive power, and in 1920, superintendent of motive power.

WILLIAM KELLY, general superintendent of motive power of the Great Northern at St. Paul, Minn., has retired. Mr. Kelly was connected with this road continuously for nearly 59 years. He served as both fireman and engineman on the "William Crooks," the first locomotive of the Great Northern. He entered the service of the St. Paul, Minneapolis & Manitoba (now part of the Great Northern) as a machinist's helper in the St. Paul shops on

(*Continued on next left-hand page*)

November 25, 1876, and in 1878 was advanced to locomotive fireman. After three years in the latter position Mr. Kelly was promoted to the position of engineman and early in 1892 became locomotive foreman at Willmar, Minn. Later in the same year, when the Great Northern was completed through to the Pacific coast, Mr. Kelly was sent to Spokane, Wash., as division master mechanic. In 1903 he became general master mechanic at Spokane, and in 1916, assistant superintendent of motive power with the same headquarters, being transferred to St. Paul a year later. On February 25, 1920, he was appointed general superintendent of motive power.

Roy F. Abell, assistant mechanical engineer of the International-Great Northern (a unit of the Missouri Pacific Lines), has been appointed mechanical engineer, with headquarters at Palestine, Tex. Mr. Abell was born on December 18, 1896, at Parsons, Kan. He took extension work at Washington University for three years and studied for another year at the Ranken school of mechanical trades in St. Louis, Mo. Mr. Abell entered railway service in 1912 as a machinist apprentice on the Atchison, Topeka & Santa Fe at Albuquerque, N. M., where he was advanced to machinist in June, 1916. In the following year he went with the Missouri-Kansas-Texas in the same capacity. In April, 1918, he entered the United States army, serving overseas until September, 1919. Following the war he resumed his position as a machinist on the Katy at Parsons, Kan., and in May, 1920, was transferred to St. Louis. In 1923 he became a draftsman for the International Shoe Company, and in 1924 took a similar position with the Commonwealth Steel Company at Granite City, Ill. From September, 1925, to July 15, 1928, Mr. Abell served as a general draftsman for the Missouri Pacific Lines at St. Louis, then becoming assistant mechanical engineer of the International-Great Northern with headquarters at Palestine.

Purchasing and Stores

H. Hyslop has been appointed assistant to the purchasing agent of the Boston & Albany, with headquarters at Boston, Mass.

C. C. Warne, purchasing agent of the New York Central at New York, has had his jurisdiction extended to include also the Boston & Albany.

F. S. Austin, purchasing agent of the Boston & Albany at Boston, Mass., has been appointed assistant purchasing agent of the New York Central, with headquarters at New York.

J. H. Logan, storekeeper of the Southern at Jacksonville, Fla., has been promoted to the position of division storekeeper, with headquarters at Ludlow, Ky., succeeding E. L. Tavlin, who has been retired at his own request because of ill health.

J. G. Warnecke, district storekeeper of the Burnside (Chicago) store of the Illinois Central, has been appointed division storekeeper at Markham (Chicago), with jurisdiction over a newly-created division store that has been established to handle material for all departments of the Chicago Terminal and Illinois divisions. The district store at Burnside has been abolished. Hereafter material for all departments on the Springfield division, which heretofore has been furnished from the Burnside store, will be supplied from the division store at Centralia, Ill., where J. W. Cockrill is division storekeeper.

Victor R. Naylor, district material inspector on the Southern Pacific at Sacramento, Cal., has been appointed general inspector of stores with headquarters at San Francisco, Cal. Mr. Naylor has been connected with the Southern Pacific for 27 years. He was born on May 24, 1892, at Cleveland, Ohio, and entered railway service on July 10, 1908, with the Southern Pacific, serving in various capacities from counterman to section stockman with the Sacramento district stores until May 18, 1912, when he was appointed storekeeper at Tracy, Cal. On December 15, 1917, Mr. Naylor was advanced to division storekeeper of the Stockton division, being transferred to the Tucson division on December 1, 1920, and thence to the Sacramento division on November 1, 1923. From October 1, 1932, to June 10, 1935, Mr. Naylor served as district material supervisor of the Sacramento district. His appointment as general inspector of stores became effective on the latter date.

Victor R. Naylor

Obituary

James R. Groves, who retired in 1917 from the position of superintendent of machinery on the Colorado Midland, died recently in Grand Junction, Colo., at the age of 88 years. Mr. Groves, who served his apprenticeship in the Altoona (Pa.) shops of the Pennsylvania, went West in 1869 and had also been superintendent of machinery on the St. Louis-San Francisco and the Denver & Rio Grande Western.

H. C. Caswell, locomotive shop superintendent of the Wabash at Decatur, Ill., died suddenly on July 3. Mr. Caswell was born on December 12, 1883. He entered the service of the Cincinnati, Hamilton & Dayton as a machinist apprentice, at Lima, Ohio, in 1898. He completed his apprenticeship in 1901, and from 1902 to 1903 was enginehouse foreman at Hamilton, and from 1904 to 1905, general foreman at Findlay, Ohio. He then left the employ of the C. H. & D. to become general foreman of the Baltimore & Ohio at Cincinnati, Ohio. From 1911 to 1912, he was shop superintendent of the Pere Marquette at Saginaw, Mich., and from 1913 to 1919 was shop superintendent of the Delaware, Lackawanna & Western at Buffalo, N. Y. He was master mechanic of the D. L. & W. at Binghamton, N. Y., from 1920 to 1922, and master mechanic at Buffalo from 1923 to 1925. He became general foreman of the locomotive terminal of the Wabash at Delray, Mich., April 1, 1926, and on April 1, 1927, was appointed superintendent of the main locomotive shop at Decatur.

H. C. Caswell

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Threading Machines.—The Landis Machine Company, Inc., Waynesboro, Pa., describes in Bulletin No. D-84 1¼-in. and 2-in. pipe and nipple threading machines.

Aluminum and Its Alloys.—Fundamental information concerning alloys is contained in the revised edition of Alcoa Aluminum and Its Alloys recently issued by the Aluminum Company of America, Pittsburgh, Pa.

J. & L. Comparator.—The J. & L. pedestal comparator and measuring machine for general shop use is described and illustrated in the 24-page catalog issued by the Jones & Lamson Machine Company, Springfield, Vt.

Oil Seals.—The Garlock Packing Company, Palmyra, N. Y., has issued a booklet descriptive of the Garlock "Klosure" oil seals. The object of these seals is to retain effectively the oil in stuffing box bearings of rotating shafts. These Klosures are available in sizes ranging from ⅜ in. to 3 in. diameter.